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Proceedings of the

FORT UNION COAL FIELD SYMPOSIUM

Volume 4

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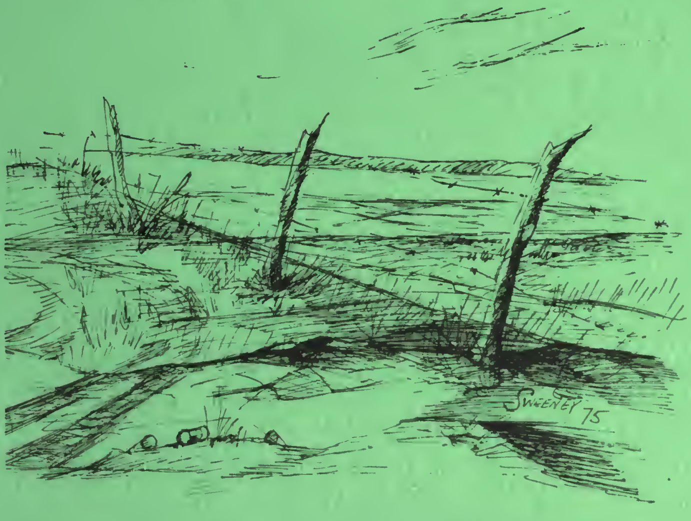

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VOLUME 4

- papers of the SOCIAL IMPACT SECTION

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USING FORT UNION COAL TO MEET NATIONAL ENERGY DEMANDS: A TEST OF OUR SOCIAL AND ECONOMIC VALUES AND SYSTEMS

Michael J. Murphy*

INTRODUCTION

The value of a natural resource is determined by the interaction of scarcity, technology and human values systems. We humans define which natural resources are useful and how they are to be utilized. We determine what balance, if any must be struck between energy production, environmental quality and social and economic well-being (1). The advent of the "energy crisis" and, just preceding that, the environmental movement, has sharply focused our attention on the competing -- and often conflicting -- goals we hold with respect to natural resource development and use.

The possibility of greatly increased coal extraction and conversion in the Fort Union region and, in addition, increased conversion of Fort Union coal outside the region, offers the opportunity to reassess our past attitudes and behavior toward all of our resources, including coal. It is this opportunity which will provide us a means to take stock of the social, economic, political and institutional impacts of our resource consumption behavior; and to develop orderly and intelligent programs aimed at re-directing our behavior in ways more nearly compatible with human well-being.

Mankind and, in particular, we Americans, have reached the turning point in terms of ensuring adequate supplies of resources to meet human needs in the future. For two centuries, we have used our resources as if there were no bottom to the pile or the well. These resources were an inheritance, a gift. They were given to us in abundance, in places easily accessible and cheaply developed.

Now, we are faced with having to obtain those resources which are no longer cheap or easy to get. In part, they are more costly because our affluence, given us by cheap resources, has afforded us a new perception of ourselves, our fellow man and our environment.

In essence, we have used our inheritance. There are no more free gifts just as there never have been any "free lunches." And, as if it isn't difficult enough for us to perceive that the basic development and use of these resources is going to cost us more in terms of dollars, we also have begun to perceive that these same resources are creating new and even more complex societal impacts - the costs of which we either do not know or do not know how to calculate or pay.

It is with these basic thoughts that we must begin to understand what is required if we are to achieve a desirable balance between energy supply, environmental protection and social and economic well-being of people affected by the development and use of Fort Union coal. Many of our goals, while appearing quite consistent, are, in fact, competitive. People want plentiful and cheap energy, clean air, a pleasant landscape and unpolluted land and water; industry wants to be cost-effective to best serve the people who want the products and services; and our sense of equity dictates that a fair share of both the costs and benefits - social, cultural and economic - should be borne proportionately by both the suppliers of energy resources and the users of the energy produced from them.

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It is important for us to face the fact that, whether we like it or not, we are in this thing together. While we may desire to sever (and we sometimes succeed) our relationships with the rest of the country; such a situation is short-lived, at best. Our notions of self-interest and of maintenance and protection of our own lives tend, because of our recurring shortsightedness, to develop one-way barriers. In short, our values are selective. Two interesting desires or beliefs - "No Tresspassing" and "Don't Fence Me In" are typically present at the same time, for example.

What is at stake in energy development and use in the United States is the need to find methods with which we can equitably manage that development and use so that no one region, group of people, lifestyle or environment is disproportionately affected.

I would submit that it is no longer a question of whether Form Union coal should be mined to meet national energy demands.

Rather, the real questions are: How much do we mine and use? Where should it come from? What price will it take to cover those costs which we can quantify? Can we offset and/or reduce those social and cultural costs which we cannot quantify? At what point do all of these costs become unmanageable? Who should pay these costs? What is the responsibility of the user of the energy to the supplier? Finally, are our existing social and economic systems capable of addressing these major questions?

I would suggest that our existing social and economic systems are not adequate to address these major questions, least of all to provide solutions.

THE SITUATION:

The production of Fort Union coal has accelerated dramatically in recent years with most of the coal mined today designated for utilization outside of the coal-bearing region.

Until quite recently, this increased demand has been a product largely of our free market system. As we all know, when the cost of one energy form increases, or its supply decreases, the market forces move to another energy form. The advent of the environmental movement and resultant regulations have rapidly increased moves from one energy form to another and have resulted in greatly increased demands for Fort Union coal.

For example, coal production in Montana has grown from

371,000 tons in 1967, all for in-state consumption; to about 14,100,000 tons in 1974, of which about 13,250,000 tons were exported to the Midwest (8). Estimates for 1975 indicate that in-state consumption will total 1,220,000 tons while exports will total about 19,600,000 tons (6).

At the same time, major utilities operating outside the states covering the Fort Union area are planning the use of Fort Union coal through mine-mouth conversion and exports of coal for electric or synthetic gas energy to serve major demand centers both east and west.

UTILITY DECISION MAKING:

To those who would suggest there is some concerted plan or plot to exploit the Fort Union formation for use elsewhere, I would submit that the patterns of demand could hardly support any plan or plot. Disorganization and differing policies within the energy industry are obvious. There are electric utilities operating adjacent to one another in Minnesota; one planning over the long-term to import Montana coal for load-center conversion; and one planning mine-mouth conversion in North Dakota and transmission via EHV lines to Minnesota.

Why this basic difference between two adjacent energy suppliers? Why don't both bring coal in from Montana? Why don't both build plants in North Dakota? Why don't both use Midwestern coal?

The reasons are complex, yet critically important if we are to attempt to understand and to best manage any level of development and use of Fort Union coal.

We should understand the basic decision making process within the average electric or gas utility. Equally important, we should understand what is absent in the decision making of an average electric or gas utility.

Ideally, if we eliminate marketing, advertising, lower per-unit pricing incentives and the like, and examine the shell of a utility, we find that the decision process centers on how to maximize the use of borrowed capital so as to receive an adequate rate of return on which to base the borrowing of more capital, a common, forceful growth ethic.

One utility brings coal from Montana to Minnesota because it is the most economical choice for its system. It is larger; it is an investor-owned system; it desires to have its major facilities located close to the service area. The other system, two large cooperatives, already have one plant in North Dakota; have different financial operations; serve a different, more rural area, with different consumption patterns for both peak and average demand.

The average energy company is not truly sensitive to the basic elements of social and cultural well-being. And, I am not sure they ever will be. These companies are sensitive to laws, regulations and direct social and economic force, not to the subtleties of human values and quality of life.

This is unfortunate, but it is a fact of life. In the late 1960's and early 1970's, the American people tried to instill in the business world a greater sense of corporate morality and responsibility. Some would argue that effort failed. I would argue it succeeded as best it could. We've learned that the business world is only as responsible as we make them be. We've also learned that the framework for corporate decision making is not a totally adequate place in which to address our concerns for quality of life, life-styles and values.

When a utility plans future system additions and fuel requirements, it surveys the capital and operating costs relating to the plant and attendant facilities; and it examines the various fuel alternatives. Calculations relating to cost are a function of existing laws and regulations. These calculations do not include the value a Montana rancher places on the fact that two previous generations of his family put down roots in the Colstrip area and that both a labor of love and a desire to grow resulted in a ranch and a way of life which is highly desirable. The alternatives examined by utilities for choice of fuel, method of conversion, location of plant site and transmission/transportation route, etc., are a function of dollar costs, not socio-cultural values.

The long-run demand for Montana coal for use in Minnesota will be determined by its price as compared to other coal sources in the United States and cost of nuclear energy as the next suitable alternative in the foreseeable future.

For the immediate future, since fuel costs, and associated transportation charges, can be passed directly to the consumer without regulatory proceedings because of the existence of fuel adjustment clauses in most utility service contracts, the lower price of Montana coal is highly attractive to Minnesota utilities in comparison to coal from states along the Ohio River Valley.

In addition, the capital costs of sulphur-dioxide removal are less if one utilizes western coal, to say nothing of the availability of suitable technology to treat effluents from midwestern coals.

What all this means is that the current and growing demand for Fort Union coal is the result of a complex set of uncoordinated events which have occurred over the past decade or so - mostly in the past five years. Fort Union coal is located in the right place; the price is right; the demand is present and the profit motives for the key free enterprise actors are alive and well.

What is unfortunate, however, is that the impacts and adverse effects of demands for Fort Union coal also have been identified and, in many instances quantified; yet our public and private decision making systems have not yet sought out or developed suitable methods for dealing with them and incorporating these costs in the price of coal or energy produced from it.

THE NEXT DECADE:

During the next five years, coal demands from the Fort

Union formation states can be quite accurately calculated because conversion facilities either are in operation or are under construction. The following table indicates the anticipated levels of production for in-state use and export for the three states for the years 1975 and 1980.

Between 1980 and 1985, the next-easiest timeframe to examine, the demands for Fort Union coal increase quite dramatically, based on present predictions both in terms of overall energy demand and the advent of coal gasification. Wyoming forecasts indicate that production could reach anywhere from 140-240 million tons by 1985 (4).

It should be noted, however, that these 1985 figures are merely predictions based upon other forecasts -- all subject to a great deal of hypothesis about the future and a significant lack of relationship to the existing energy marketplace.

Montana-Wyoming-North Dakota
Coal Production For In-State And
Export For Years 1975 and 1980
(millions of tons)

		1975		1980	
State	Ref.#	In-state	Export	In-state	Export
Montana	(6)	1.2	19.6	9.4	33.4
Wyoming	(4)	7.7	21.8	15.0	96.0
North Dakota	(5)	7.9	.5	13.6	.5
TOTALS		16.8	41.9	38.0	129.9

NOTE: The in-state figures also include coal for export of electricity.

Again, using Minnesota as an example, the supply and price of other fuels is critical to the impact on the Fort Union coal beds. Minnesota, tightly bound to Canada for its source of crude oil, will shortly experience major reductions in availability of fuel from that source. Minnesota is about 80% dependent upon Canadian crude for its refineries, and more than 50% of the states gasoline supply and about 45% of its fuel supply depends upon Canadian imports (2).

At the same time, Minnesota's natural gas pipeline supplier has announced plans to curtail all interruptible customers using more than 200,000 cubic feet per day by 1978 (7). It is understood that this curtailment program may be expanded shortly to include interruptible users served at 100,000 cubic feet per day (7). In addition, the Federal Power Commission has ordered all utilities off natural gas by the end of 1977. In Minnesota, more than 200 municipal electric power suppliers now use about 40-billion cubic feet per year, an amount equivalent to nearly 3,000,000 tons of coal rated at 9,000 Btu's/pound (7).

Obviously, there are no simple solutions to these shifts in energy usage in the immediate time ahead. However, these municipals and many other affected natural gas users already are studying their long-term options, including Fort Union coal supplied them directly or through energy from larger local utilities.

In addition, the taconite industry, a major source of iron ore for the U.S. (a source which will play a major steel-supply role for another 35-40 years), also is a large user of natural gas. In 1974, that industry consumed about 40 billion cubic feet, or 10% of the state's total natural gas supply; and 20% of the state's total electric power production, and amount equivalent to 2.85 million tons of coal rated at 9,000 Btu's pound (2).

The taconite industry is a logical candidate for synthetic natural gas at a point in time prior to 1985. Whether or not it obtains synthetic natural gas, where the coal will come from and where the conversion facility is located will be function of the decision making processes which take place in the various affected states.

There is evidence that demands for alternative fuels - western coal, in particular - will continue to occur and increase in high demand sectors in the western Great Lakes region. Other regions of the U.S. also have announced demands for Fort Union coal.

SEEKING SOLUTIONS - CHOOSING ALTERNATIVES:

As with any energy decision making process, elements of time are very critical. Equally significant is the well-documented fact that today's energy decisions are often irreversible because of their capital intensive nature, long-term operation and effects, and; interestingly enough, the American public's record for developing apathy and seeking accomodation.

Because of these factors, any solutions we develop must simultaneously entertain the urgency of the immediate situation - demands are growing, decisions must be made - with the longer-term questions of lifestyles, values and the economy.

Ideally, the education of key decision makers and the general population of the high demand areas east of the Fort Union region should be a major element of a total solution for managing any level of production and use of the coal at issue. However, such an education process - call it a lesson in sensitivity and social awareness - takes time; time which is not currently available within the present decision making process which today is dictating where the U.S. will obtain its immediate and longer-term energy supplies.

There is a growing volume of evidence that consumption patterns are shifting back toward accelerated growth patterns. Crude oil consumption topped 18.4 million barrels per day in March. On the Northern States Power Company system in Minnesota, demand growth is currently running at a calculated rate of 6% per year. This rate is in contrast to the previous demand curve which began declining from 8% early in 1973, flattening out for a few months in mid to late-1974 (3).

I think we are beginning to see that the consuming public is not terribly sensitive to either the urgency of our national energy dilemma or the high prices of the various fuels we use. Particularly, in the absence of alternatives or because of the lack of capital with which to improve efficiency, the consumer tends to fall back into previous use habits.

On the other hand, the coal-consuming utility is extremely sensitive to higher fuel costs due to several factors, including: interest rates, declining net return on investment, increasingly stringent regulatory action and the high cost of planning in the face of growth uncertainty.

It is because of this high degree of utility sensitivity that I perceive several kinds of tools and alternative plans which can be applied to the managed development and use of Fort Union coal. It is highly probable that some of these alternatives will pose even more questions and "what its" than they will solutions.

While it is important to study and to understand the impact of various levels and locations of coal development and conversion within the Fort Union area; it is equally important to understand the various motives behind demand for that coal from outside the Fort Union area.

As was noted earlier, when a utility perceives a future demand and moves to study methods to satisfy that demand, the questions asked center on what are the straight-line economic alternatives which will affect decisions within the utility's basic corporate philosophy, It is at this point where I believe the decision making system breaks down or fails due to a lack of important inputs.

This breakdown is due in part to the separation of decision making between government and private interests. It equally is due, I believe, to the absence of any kind of cooperative analysis among the states involved.

Let us begin with some basic assumptions:

- Fort Union coal is being mined and burned and the rate of mining will increase significantly between now and 1985 due to contractual commitments and certain irreversibilities in demand.

- Many plans and physical developments nowunderway will cause increased mine-mouth and load-center conversion of Fort Union coal after 1985.

- While the socio-economic costs are significant today, many are mini-scule when compared with the same kinds of costs resulting from projected use of Fort Union coal.

- Existing state revenue-producing programs generally are not adequate to cover the increased costs occurring in the coal-producing regions.

- The urgency of the situation created by these present and anticipated costs has caused a proliferation of study, speculation, blame-placing, confusion and arbitrary and single-purposed actions by various state governments in both supply and demand states - actions which may or may not be solution-oriented and are, to a large extent, short-term.

- The using public does not perceive the total net effect of their demands for Fort Union coal. The utilities are not addressing these key social issues.

- States involved in managing Fort Union coal production are taking significant steps to develop orderly processes -- processes which have a direct bearing on the price of the coal produced. Consuming states, on the other hand, are oriented toward holding down energy costs by seeking the cheapest fuels with which to power their own economy at a continued growth rate. This difference in approach to the same issue is critical.

- While it would be ideal if the introduction of other energy sources such as solar energy and fusion power could be accelerated to become effective within the next decade, such accelerated introduction could be highly inflationary. The orderly transition from one energy source to another in direct relationship to both availability and price is fundamental to the development of sound, long-range energy policy for the United States.

- A logical and necessary goal for energy policy is the development of pricing systems which incorporate all of the costs which can be quantified and which allow for the application of cost-influencing regulations or policies designed by state governments to protect its resources and its people within the framework of that state's long-term goals and values.

- While there is a general and serious absence of understanding of the cause and effect relationship involved in the supply of anddemand for Fort Union coal among the involved states, it is doubtful there is some form of conspiracy or plot to "rip-off" the western states. It is a knowledge vacuum which is largely responsible for the growing dichotomy.

Now, let us add a few potential policies for the various states which could contribute to alterations in the way in which Fort Union coal is supplied and consumed.

- No coal-bearing land should be stripped unless there is substantive evidence that it can be returned to its prior state of usefulness and that, esthetically, the state of the land is again acceptable to its residents.

- The rights of the surface owner should be basic to any decisions relating to where mining takes place. These rights should facilitate, where necessary, re-examination of existing agreements between landowners and coal mining companies to determine the real cost and benefit to the landowner.

- A coal-producing state should have the authority to control the development of coal production and the siting of conversion facilities; especially those designed for coal or energy export respectively.

- State taxation and other regulatory policies affecting coal production and/or converson should relate directly to the costs and benefits of such production and/or conversion in those instances where either the price of the coal or the energy produced is directly affected. Inasmuch as we know something about the effect of higher oil prices on other fuels, we should understand more clearly the effect of different coal prices, on demand methods and locations of conversion and transportation/transmission facilities, etc.

- If a balanced energy system is to be established in the U.S., energy supplies out not to become revenue producers to offset other, sometimes unrelated costs.

- Individual states, be they suppliers or importers of energy, or both, should develop systems to more adequately address questions of total energy need, energy efficiency as a supply strategy, alternative sources of energy and their comparative costs. These fuel choice and supply decisions, as well as demand projections, should not be left solely to the private energy supplier.

- Involved states, both individually and collectively, should conduct extensive socio-economic analyses of the impacts of mining, transportation/transmission and conversion facilities to determine the true relationship between costs and benefits created by such facilities in order to choose the best alternatives..

- Key policy individuals in the involved states should cooperatively address those broader questions relating to lifestyles and values in order to better perceive each states particular role and responsibility, and educate their respective publics and other state government leaders.

- Total energy efficiency studies, including energy inputs for equipment and operations from the mine to the consumer as compared to net outputs, should be developed as a primary tool for making choices as to where and how energy should be supplied.

The net effect of the development of these broad potential policies listed immediately above can be the creation of a more orderly system within which we can better relate our short-term decisions to our long-term goals and values. Without this knowledge, we will most likely continue to make a multitude of micro decisions in the immediate future - decisions which, when studied for their accumulative effect could well produce larger, even more negative end results.

LIFESTYLES, PERSONAL FREEDOM, LIMITS TO GROWTH:

Much of the previous discussion has centered on the lack of integrated policy and the need for better private and public systems through which to develop equitable policies.

I would lay to rest the notion that regulation or control of private enterprise is always detrimental. If done hit-or-miss, adverse and inefficient results can be expected. If done with some degree of vision and a notion of where we want policies to take us, the net effects can be positive.

It makes a great deal of sense, particularly when we are faced with the fact that we've about used up the free or cheap resources at our disposal, to begin to place some limits upon ourselves - limits which, if intelligently applied through policies and regulations sensitive to our goals and values, can only lead to greater resource efficiency, greater freedom and improved lifestyles.

Our world has become too small and tightly interwoven to any longer ignore the manner in which we influence each others lives. While our lifestyles can continue to evolve consistent with our desires for continued and expanded personal freedom, perhaps the only limit to growth we truly face is that point in time and space beyond which we ought not venture -- the point where our actions become more costly than beneficial to those around us.

SUMMARY:

It is highly likely, given present, mostly irreversible demands and currently-voiced federal policies and aspirations, that Fort Union coal development and use will accelerate. The continued absence of broad policy assessment and planning on a multi-state basis including both suppliers and users of this fuel source only magnifies the problems which will result.

It is extremely important that a realistic assessment of the capabilities of both private and public decision making systems take place in order that their respective limitations, motivations and key leverage points for alterating decision mechanisms are better known. And, ultimately, the broad general publics of the states, individually and collectively, must be made increasingly aware of the causes and effects of their energy demands.

Individual state governments involved in the Fort Union coal supply/demand question have both the opportunity and the responsibility to work in concert to ensure that positive and orderly steps are taken to impact on Fort Union coal production and use through the powers to regulate efficiency, methods and rate of energy use and, social, economic and environmental impacts.

Coal-related pricing policies, including costs for mining, transportation/transmission of energy, conversion and associated impacts of operations, when properly applied through our "enlightened economic analysis system" can have substantial impact on the utility decision making process and the utility regulatory process in the demand states. Any pricing policies envolving from taxation must, however, relate to the costs of activities involved in coal development and use, not to other costs borne by states for their residents.

Many of the issues surrounding the use of Fort Union coal are of such urgency that some significant social and economic dislocations are bound to occur. Unfortunately and, at the same time, fortunately, these are lessons we must learn if we are to more systematically and realistically develop policies for the future.

The maintenance and improvement of the individual's values and lifestyles in the face of a changing world are fundamental. The challenge lies in our ability to maintain a high degree of flexibility in our energy and resource choices so that values and lifestyles continue to evolve naturally. Change is the only constant factor in our lives. It is orderly, however, only when we have taken the time to understand the many options available to us. Today's policies and regulations to minimize the adverse effects of Fort Union coal development can, if appropriately applied, create even greater personal choice and freedom to express individual goals and values in the future.

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* * *

THE PACIFIC NORTHWEST, A CUSTOMER FOR ROCKY MOUNTAIN ENERGY RESOURCES

George W. Hinman*

Burning Montana coal in Montana to make electricity for the Pacific Northwest no doubt raises the hardest questions of all about exploiting Rocky Mountain resources for the benefit of the rest of the country. Compared to shipping the coal itself out of the region, the alternative of converting it to electricity in Montana has some added benefits to the state in earnings paid to power plant workers plus some added purchases of goods and services in the state, but it also has added "costs" in the form of air pollution, consumptive use of water (opportunity costs), and socioeconomic stresses arising particularly from the construction activity. I believe that it is fair to say that this conference has come about because many Montanans believe that the costs exceed the benefits not only for electrical power generation but for strip mining as well. Feelings are further exacerbated by the realization that the main benefits of the electricity generation, namely those deriving from its use, do not go to Montanans but to the people of the Pacific Northwest.

I will return to this perspective of the problem again, but for the moment let me shift to the Pacific Northwest, i.e., to the states of Washington, Oregon, and Idaho, in order to consider their prospective demand for Montana generated power. As a beginning, let us consider present, or rather recent past demand for energy. Northwest consumption of energy by source and by consuming sector for the year 1971 is shown in Table 1 (1). The table shows that direct use of fossil fuels far exceeds use of electricity in the region and that households are the largest energy users, but manufacturing industries use the most electricity.

In order to estimate future consumption, it is necessary to probe more deeply into the use patterns. Figure 1 shows household use in 1971 (1). The dominant positions of automobile travel and home heating are clearly evident. However, the home heating bar needs some interpretation. Oil, gas, and coal heated homes require far more energy per household than electrically heated ones for a number of reasons. The electricity component of the home heating bar actually corresponds to electric heat in 28% of occupied houses in the Northwest. If all Northwest homes had been electrically heated in 1971 at the average heating requirement per home of 15,000 kwh/year, the total residential electricity requirement would have been about 1.9 times as large as it actually was. If such a switch to electric heating does occur during the next twenty-five years, the total effect on residential consumption would include this factor plus the effects of increasing numbers of households. Further saturation of other electric appliances is relatively unimportant. We have

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Table 1 Energy consumption in the Pacific Northwest in 1971 by consuming sector, source of energy, and function performed

		Use by Consuming Sector					Other and Unaccounted	Total Energy Cons. by source	
Energy		Households	Commercial Sector	Manufacturing Industries	Extractive Sector	Energy Industries[a]		Trillion BTU	Percent
		Trillion BTU							
Source of Energy									
Electricity	trillion BTU	107	47	138	13	40	53[b]	398[c]	24.5
Nat. gas	"	75	44	182	-	24	-1[d]	324[e]	20.0
Petroleum	"	433	232	77	43	39	25[f]	849[g]	52.3
Coal	"	7	1	8	-	3	-	19[h]	1.2
Uranium	"	-	-	-	-	32	-	32[h]	2.0
Total energy supplied to consumers	"	622	324	405	56	138	77	1,622	
	Percent	38.4	20.0	25.0	3.4	8.5	4.7		100.0
Function Performed									
Transport.		302	146	10	25	3		486	30.0
Heat supply		284	101	257	2	41		685	42.2
Electrolysis		-	-	78	-	-		78	4.8
Power (mach. and light)		36	35	60	29	1		161	9.9
Raw material, other		-	42	-	-	-	77	119	7.4
Energy conversion and distribution		-	-	-	-	93		93	5.7
Total energy supplied		622	324	405	56	138	77	1,622	100.0

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[a] Includes use and losses in electric and gas utilities (including waste heat in electricity generation) and use and losses in petroleum refining.

[b] Utility sales outside the region plus inknown.

[c] Generation by West Group plus generation by Idaho Power Co. plus BPA purchases plus industrial generation plus Utah Power and Light Sales and distribution losses in Idaho minus BPA and PP and L loads in Montana minus net BPA exports outside region.

[d] Transmission loss plus increased storage plus unknown. Industrial and residential consumption listed in table are each known to exceed control total by 10 trillion BTU. Thus actual transmission loss plus storage plus unknown is about 13 trillion BTU.

[e] Net receipts by pipeline. From Bureau of Mines, Mineral Industry Survey for natural gas, 1971. Includes storage change.

[f] Residual.

[g] From Energy Fact Sheets, 1971. Dept. of Interior, Extra energy added for petroleum refining and waste heat.

[h] Column sum. No control total available.

HOUSEHOLD USE OF ENERGY IN THE PACIFIC NORTHWEST - 1971

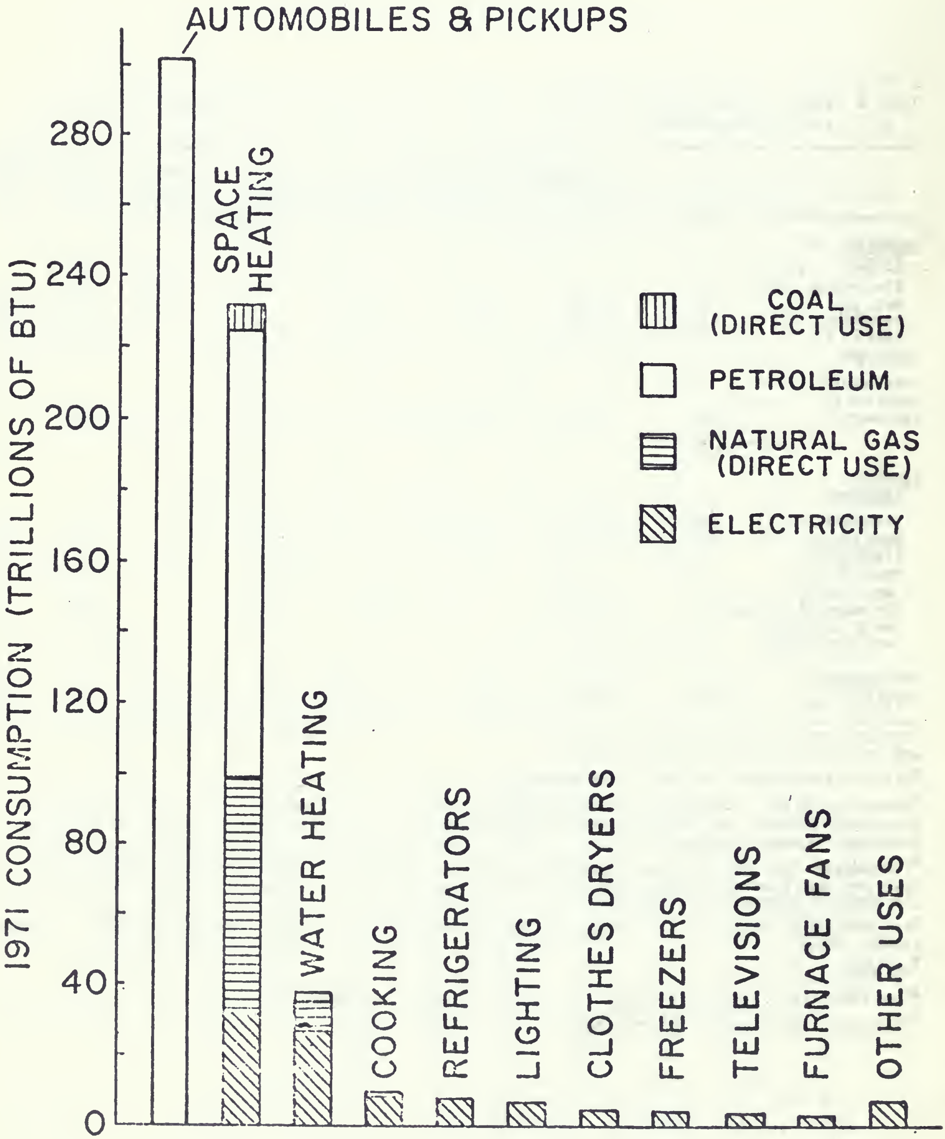

Figure 1

recently madeprojections of household numbers in the three-state region, which indicate increases ranging from 40% to 70% for numbers of households in 2000 compared to 1971. The average growth rate in residential electricity consumption between 1971 and 2000 that follows from this growth in households plus the conversion to electric heating ranges from 3.3% to 4% per year. Actually, there is good reason to believe that a complete switch to electric heat will not take place in the Northwest during the remainder of the century because of the availability in the region of Indonesian, Alaskan, and synthetic oil and because of future increases in the price of electricity. If oil and gas heating remain important, the residential electricity growth rate will be less than the 3.3% to 4% indicated above.

The 1971 distribution of energy consumption of Northwest manufacturing industries is shown in Figure 2 (1). Aluminum smelting used more than half of the electricity consumed by manufacturing industries. Most of the rest went to the forest products industry (pulp and paper, lumber and wood products), to the chlor-alkali plants that serve it, and to the elemental phosphorus production plants in Idaho. However, the portions of the bars that show the other fuels consumed give an indication of possible substitution of electricity that could increase electricity requirements even at constant levels of industrial output. Possible increases in electricity consumption arising from fuel substitutions are large, but the probabilities of substitution do not appear to be great because the future price of electricity will be higher than the prices of coal, oil, and natural gas, even though these latter fuels are much more expensive than they used to be. Furthermore, the reliability of future supply does not seem much better for electricity than for oil or coal. There is certainly plenty of coal around, and the Pacific Northwest will soon be close to the country's biggest new oil supply, i.e., Alaskan oil. Only nuclear fuels offer any prospects of making electricity from fuels that are not available for direct use. Therefore, we have assumed that changes in industrial demand come about as a result of increased output combined with response to increasing price. On the average, the use of electricity in manufacturing was projected to increase by 25% to 50% between 1971 and 1980. This corresponds to annual growth rates of 2.5% to 4.5%. The growth is expected to slow somewhat after 1980 because of the spreading influence of energy scarcity and because of possible resource limitations on expansion of the forest products industry.

The third major consuming sector consists of commercial and extractive industries. The consumption in 1971 is shown in Figure 3 (1). This most important electricity users in this sector are agriculture, wholesale and retail trades, service industries, and government. The commercial sector is difficult to project because it is uncertain to what extent past trends toward greater energy intensity will continue. Fortunately, it is small compared to the industrial or residential sectors. The growth rate is estimated to lie in the range of 2.5% to 5% in the period up to 1980.

These comments on future use of electricity in the Pacific Northwest have been qualitative. However, we have also made projections in a consistent way based on two Bureau of Census population projections, namely Series C and Series E, and two

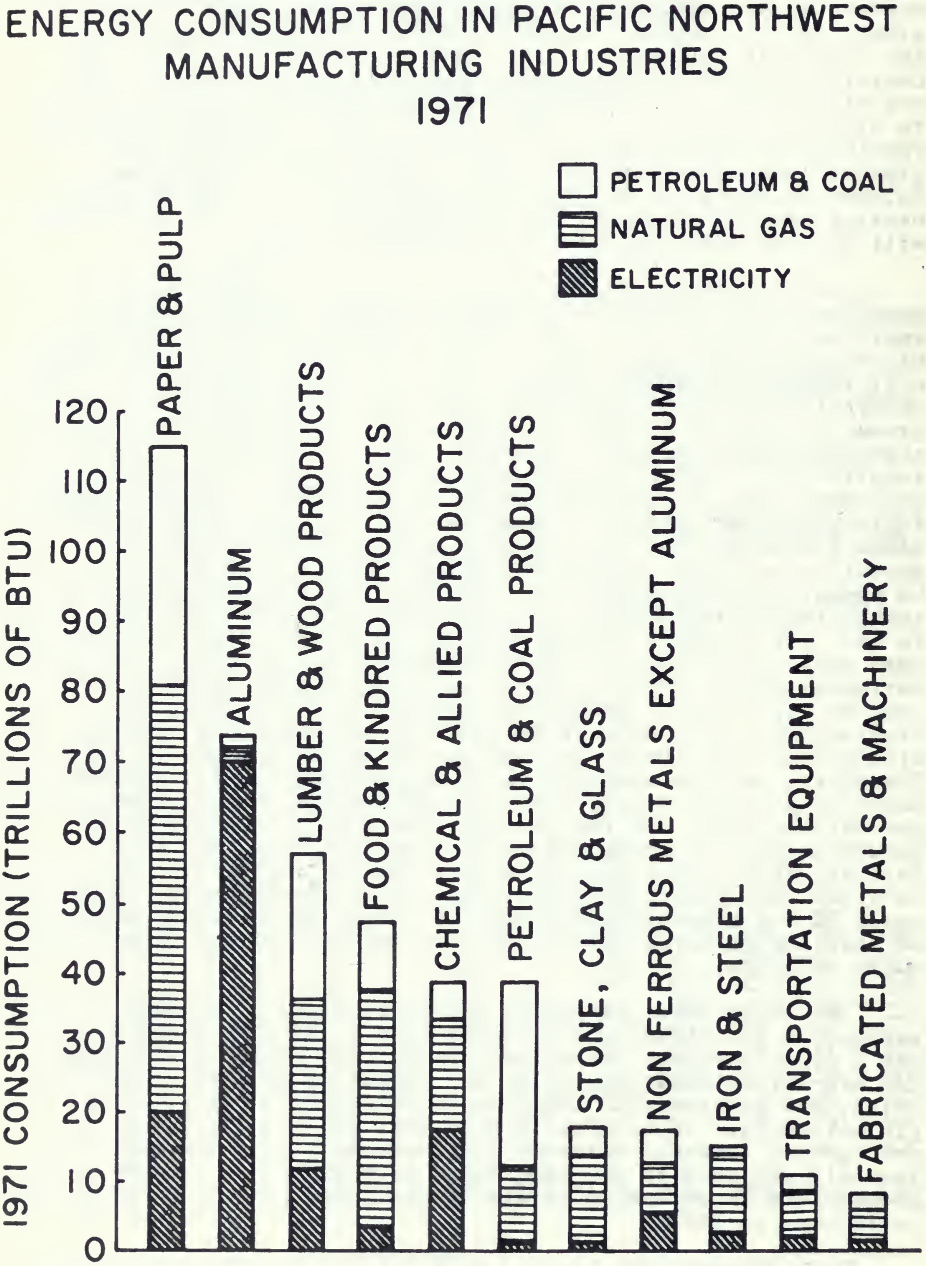
ENERGY CONSUMPTION IN PACIFIC NORTHWEST MANUFACTURING INDUSTRIES 1971
PETROLEUM & COAL
NATURAL GAS
ELECTRICITY
1971 CONSUMPTION (TRILLIONS OF BTU)
0
10
20
30
40
50
60
70
80
90
100
110
120
PAPER & PULP
ALUMINUM
LUMBER & WOOD PRODUCTS
FOOD & KINDRED PRODUCTS
CHEMICAL & ALLIED PRODUCTS
PETROLEUM & COAL PRODUCTS
STONE, CLAY & GLASS
NON FERROUS METALS EXCEPT ALUMINUM
IRON & STEEL
TRANSPORTATION EQUIPMENT
FABRICATED METALS & MACHINERY

Figure 2

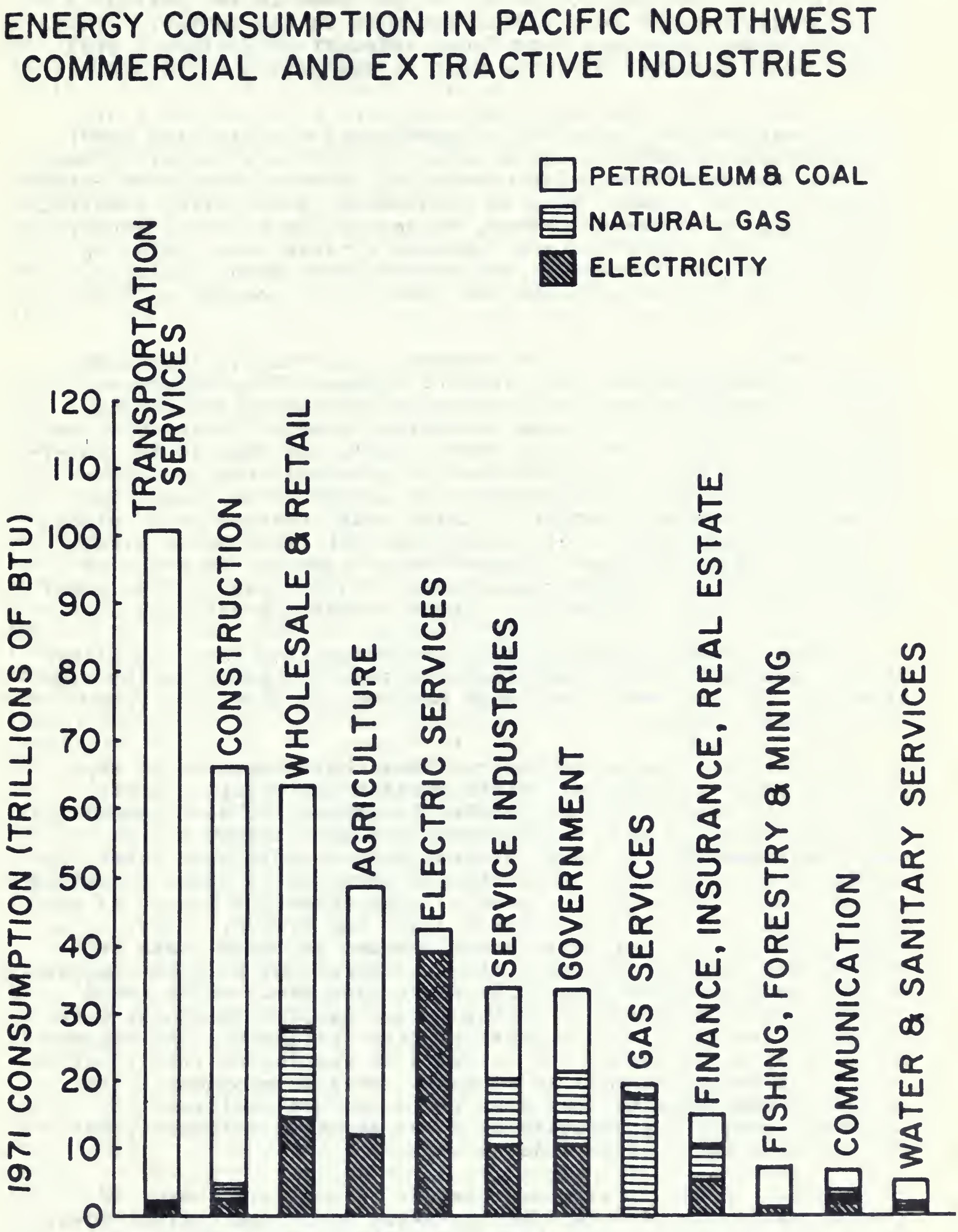
ENERGY CONSUMPTION IN PACIFIC NORTHWEST COMMERCIAL AND EXTRACTIVE INDUSTRIES
☐ PETROLEUM & COAL
▤ NATURAL GAS
▨ ELECTRICITY
1971 CONSUMPTION (TRILLIONS OF BTU)
0
10
20
30
40
50
60
70
80
90
100
110
120
TRANSPORTATION SERVICES
CONSTRUCTION
WHOLESALE & RETAIL
AGRICULTURE
ELECTRIC SERVICES
SERVICE INDUSTRIES
GOVERNMENT
GAS SERVICES
FINANCE, INSURANCE, REAL ESTATE
FISHING, FORESTRY & MINING
COMMUNICATION
WATER & SANITARY SERVICES

Figure 3

corresponding economic projections made by the U.S. Department of Commerce, the so-called OBERS projections. The result is a forecast of growth in electricity consumption in the Pacific Northwest at a rate between 2.3% and 3.5% per year in the period up to 1985 and somewhat more slowly later on in the century. This is lower than the latest West Group forecast of Northwest utilities, which averages 4.7% per year in the period up to 1985-86.

So far, this paper has been concerned with forecasts of future demands for energy and in particular for electric power in the Pacific Northwest. The range of forecasts is very broad, that is, the future is quite uncertain. Some of the basic determinants of load growth, such as population growth rate, electricity prices, other energy prices, vulnerability of other energy sources to interruption, and economic activity are deviating sharply from past trends. There are not many data available which can be used to indicate how electricity demands will be affected by these new conditions.

In this atmosphere of uncertainty, the Pacific Northwest electric utilities must plan for the future. They interpret their responsibility to be to serve all customers requesting service except for very large industrial loads. Their legal responsibility may not be quite that strict, but that is the interpretation they have used, and that is also what the public expects of them. Recent experience with construction schedules, reliability, and performance of large scale thermal power plants has been disappointing. The Centralia coal fired power plant in Western Washington has operated below capacity in order to satisfy state air quality regulations. The Trojan nuclear plant under construction in Oregon has been repeatedly delayed.

Under these conditions it is not surprising that a utility planner should estimate his plant construction goals on the high side. He is more concerned about maximum possible load than most probable load.

There are a number of sources that could conceivably supply additional electricity to the Pacific Northwest. First, there is the possibility of further hydroelectric development (6). The main rivers in the Pacific Northwest are largely but not completely dammed up. There do remain some additional sites, but most of the larger onesare located in areas where there is strong opposition to a new dam. A good example is Hell's Canyon of the Snake River on the border between Idaho and Oregon. There is an application by the Northwest Power Company to build a dam or dams in the canyon. However, there is a current bill in Congress to make Hell's Canyon a National Recreation Area, which would preclude such development. Other rivers besides the Snake with important remaining hydroelectric potential include the Salmon and Clearwater in Idaho, the Columbia in Washington (Ben Franklin site), and the Clark Fork in Montana. Full development of remaining hydrosities of this kind could produce additions to Northwest generating capacity of a few thousand megawatts, but the environmental costs would be high.

Nuclear power is also expected to be a future source of electric energy in the Pacific Northwest (4). One nuclear power plant is currently in operation (at Hanford, Washington), two are under construction, and eight others are planned. However, nuclear power has its problems, as everyone knows. The plant costs are very high, construction is never completed on time, plant performance has not been good, there is substantial opposition to individual plants, and there is growing national concern about all nuclear power. It is not surprising that electric utilities should seek diversity in their sources of supply.

The other fuel that Northwest utilities consider to be sufficiently cheap and reliable to use in electricity generation is coal. There is one coal fired power plant currently operating in Western Washington, and another is under construction in Wyoming to supply the Northwest. The West Group forecast (4), dated February, 1975, includes the Colstrip 1, 2, 3 and 4 plants in Montana in its resource schedule which extends through 1985. Other future use of coal in the Northwest involves transportation of the coal rather than the power.

This report so far has reviewed Pacific Northwest electric power consumption, present and future, and future sources of supply. One of the possible future sources is Montana coal. So far Northwest utilities have proposed to use it in power plants that are located in the mining areas rather than the load centers. The utilities environmental assessment (3) indicates that transportation costs favor transporting the power rather than the coal. The staff report of the Department of Natural Resources and Conservation (2) contests this conclusion. The main point of contention, however, is not the economics of energy transportation but social and environmental impacts. I do not intend to review this complex subject, which occupies much of this present meeting and which has been extensively discussed already. However, I would like to offer the view that the response to the problem should be to institute a set of regulations and a program of compensations to Montana citizens that will make coal development acceptable provided that the regulations are satisfied and the compensations paid. The result of such an energy policy could very possibly be that coal export rather than power export would be favored, but power plants would still be possible under some circumstances. For example, limitations on water available in Montana will presumably limit the number of power plants that can be built in the state, but there may be adequate water for some plants. A similar statement could be made with respect to ambient air quality standards.

This type of policy contrasts with one that specifically prohibits access to the resource. It does not seem possible that this latter type of state policy could stand up against the national need for energy, and it would presumably lead to federal preemption of authority for coal development.

Each region has adjustments to make in response to the changing patterns of energy supply. In the state of Washington, the prospect that Puget Sound will become a trans shipment point for Alaskan oil to other parts of the country is a controversial topic. A citizen's council which was appointed by Governor Evans and of which I was a member, recently wrestled with this question (5). Northern Puget Sound has deep water harbors for large tankers. It also has existing docks and refinery facilities. All of these facilities make it a good receiving point for Alaskan oil including possibly crude oil to be shipped on by pipeline to the Midwest. Standard Oil of Ohio owns over 50% of the present Prudhoe Bay oil. Since SOHIO has no marketing operations on the West Coast, there is a motivation for them to build a pipeline to move their oil back to the Midwest. However, tankers moving across the Northern Sound run a risk of accidents which could produce crude oil spills that would severely damage this vulnerable area. The citizen's group was asked to recommend policy in this case. They recommended a policy that permits increased waterborne imports of crude oil to Washington and trans shipment of crude oil across Washington but restricts further increase in tanker traffic to terminal sites outside the Sound. The policy has not yet been implemented by the state legislature.

I recount this example because the principle used to establish policy was the one that I mentioned above, namely to establish regulations and compensations to protect State interests but not to prevent the utilization of the resource entirely. Concern about federal preemption of deep water port siting played a role here as did a feeling of responsibility to the country as a whole. Council members were responsive to the argument that we are all citizens of the United States and have obligations that follow from this fact. We felt that we could protect our state and yet make a contribution to solving the nation's energy problems.

It seems to me that Montana is already applying the policy that I mentioned above; namely, setting up regulations and compensations to protect state interests but not prohibiting all access to the coal. The regulations include the possibility of mine site power plants. The remaining question is how the policy works out in practice. I suggest that it is in Montana's interest to insure that it works out well enough for the rest of the country that the federal government is not prompted to preempt authority to legislate in this field.

On the other hand I believe that it may very well be in the national interest for the federal government to preempt at least part of the present state authority to regulate the nation's energy industries. The interdependence of energy producers and consumers in different parts of the country seems to me to be a situation requiring federal control. For example consider the forthcoming decision on the Colstrip 3 and 4 plants. If the Board of Natural Resources and Conservation should disapprove the application to build the plant because it concluded that the Pacific Northwest did not need the power, I would think that the denial would be contested on constitutional grounds regardless of the merits of the conclusion. The basis would be that Montana would be acting to restrict interstate commerce (7). Such a conclusion could better be reached by a federal commission set up to consider site applications on a national basis. On the other hand state regulation of environmental quality is already consistent with national policy. Therefore restrictions on power plant construction or coal development based on environmental quality regulations seem more likely to stand up against such criticism.

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THE MONTANA ENERGY POLICY STUDY AND THE FORT UNION COAL BASIN

Richard L. Bourke*

INTRODUCTION

As staff economist for the Montana Environmental Quality Council I have spent much of the last fifteen months researching data and analyzing issues contained in the Montana Energy Policy Study, released by our office about two months ago.

The Montana EPS was initiated in response to a resolution of the 1973 Montana legislature. That resolution called for the EQC to undertake a study and make recommendations to the state concerning the development and implementation of a state energy policy as it may relate to an emerging national energy policy. Since the publication of the North Central Power Study, in the fall of 1971, Montanans had become increasingly aware of the extensive coal development being planned for their state.

The Montana EPS did not suggest a comprehensive energy policy for the state of Montana. That process is still going on, as it properly should be.

The study is designed to provide the most up-to-date data available and policy recommendations to assist Montana's citizens and its legislators in developing a state energy policy. It presents information on the current energy situation from a national as well as a state perspective and closely examines past energy trends and the assumptions behind future projections and their impact on Montana. This information was used to outline some policy options that would insure the state's energy supply future and at the same time, promote long-term economic stability and maintain environmental quality.

Although time prevents going over the study in detail I would like to briefly describe its contents. Part I provides a basic overview, from a national and state perspective, of recent historical trends in supply and demand for petroleum, natural gas, coal electricity, and uranium. Part II summarizes and compares projections and energy policy scenarios developed by the Federal Energy Administration's Project Independence, the Ford Foundation's Energy Policy Project, and the Northern Great Plains Resources Program. These analyses are followed by a close look at the potential for energy development in Montana. Particular attention is paid to uranium, strip mining, coal gasification and liquefaction, and electric generation and the resultant impacts on water and land resources, energy costs, and net energy. Part III examines the feasibility of a variety of alternative energy sources for Montana, including solar energy, wind power, geothermal, and photosynthesis.

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The Appendices also form an integral part of the report. New information with important policy recommendations is presented on fossil fuel taxation, utility rate restructuring, and the net energy effect of the east-west coal shift. Other Appendices review Montana State agency energy related programs and state laws relating to energy.

The principal finding of the study is that Montana must take immediate action if it is to protect much of its long-range agricultural base, its economic stability, its environmental quality, and its unique way-of-life. In the absence of Montana acting to determine its own destiny, the state's future will be dictated by the federal government and the energy conglomerates whose actions, if history is any guide, will be based upon expendience and profit maximization and may not coincide with what is best for Montana.

Relating this major finding to today's symposium is not difficult. Essentially we are saying that Montana's energy policy planning, which in a sense has already begun, must adapt and be flexible enough to respond realistically to the political and industrial environment in which it is being developed. It must be based upon sound facts and analyses in order to have broad-based support, it must identify achievable goals, and it must be implemented in politically and economically realistic ways.

THE EMERGING NATIONAL ENERGY POLICY: ITS MEANING FOR MONTANA

Today the vast, arid expanses of eastern Montana are being looked to by both the federal government and the energy industry for supplying much of this nation's future energy needs. It is clear that the country must endeavor to become more self-sufficient in energy production and that coal will play a major role in this national drive for energy "independence." What is not clear is the rationale for the ground rules being developed in this quest for energy.

Should we commit ourselves to supplying projected energy *demands* based upon historical trends or should we endeavor to differentiate between these *demands* and valid energy *needs* required to meet a future scenario based upon alternative conservation assumptions?

To what extent should our western coal be developed as opposed to mid-western or eastern coal? How fast should this development take place?

Will coal or uranium conversion facilities eventually dot our landscape, or can we develop support in the decision making centers of our state and nation for siting these facilities where the need for power is the greatest, at the load centers?

Finally, and most importantly, can we as a citizenry and a state make and implement those decisions that will best allocate our state's resource wealth for the benefit of present and future generations of Montanans?

To begin with we must take a careful look at the industrial plans for developing eastern Montana's coal resources. 1974 coal production in Montana totalled 14.4 million tons; current long-range coal contracts call for 50.8 million tons to be produced in 1980 (16). As Table I shows this is between the Northern Great Plains Resources Program (NGPRP) intermediate coal development profile and the production called for in its extensive development scenario. It is also very close to the Project Independence accelerated development projection for 1980 of 57 million tons per year. This could be reached by merely expanding current mine production (15). It is probably safe to conclude that we will approach these accelerated development scenarios.

Table I*
Montana Coal Production Projections
(Million Tons Per Year)

Year	NGPRP (Intermediate)	MEAC*	Project Independence (Accelerated)	NGPRP (Extensive)
1975	20	20.8	--	20
1980	41	50.8	57	64
1985	75	--	96.3	153
2000	133	--	--	393

*Sources: (16) (17) (22)

The potential for increased coal production is great: presently there are 666,700 acres of coal mineral rights leased in Montana, another 449,800 acres that are optioned to lease, and 439,600 acres on which prospecting permits are held with an option to lease (18). These 1.56 million acres are held by 16 major corporations and exceed by about 400,000 acres the estimate of Montana land underlain by economically recoverable surface mined coal (17). Of course all these acres will not be mined but this magnitude of activity indicates the extreme interest and industrial pressure for developing these coal reserves.

About 80 percent of the coal being mined in Montana is being shipped to markets in Minnesota, Wisconsin, Illinois, Michigan, and as far east as West Virginia and Tennessee. Coal has also been contracted for shipment as far south as Austin, Texas. In the short term, Montana coal for export is expected to keep its competitive advantage in these markets due to its capability of meeting supply requirements and its low-sulfur content. After 1985, Montana coal probably will remain competitive due to its price advantage over other coal, its closeness to growing northwest, north central, and west coast markets, and its ready availability to meet long-term supply commitments.

Another area of concern for Montanans is the possibility of in-state coal conversion facilities. These facilities would convert coal to pipeline quality synthetic natural gas, liquid fuels (gasoline), or electrical power. The electric power may be required to run a uranium enrichment facility as well as for direct distribution to more conventional consumers.

We are all familiar with the current debate over the proposed steam electric generation facilities at Colstrip, namely Colstrip 3 and 4. Burlington Northern has proposed a combination ammonia/liquid fuels production plant northwest of Circle, Montana. This plant would consume between 5.5 and 13.7 tons of lignite coal per year. Water requirements are unknown, however BN has applied to appropriate 67,000 acre-feet per year (afy) from the Timber Creek arm of Fort Peck reservoir for plant use, reclamation, and irrigation (13).

Plans for additional conversion facilities are unknown other than those referred to in public, or private, conversations. In the former category would fall five "standard" size synthetic natural gas plants proposed by Westmoreland Resources and Peabody Coal Company for southeastern Montana, each consuming about 10 million tons of coal per year and 10,000 afy of water. Five additional gasification facilities could be considered falling into the latter category (16).

Since water is required for the operation of any of these facilities it is instructive to closely examine applications and options for water from eastern Montana's reservoirs and rivers. Table II outlines industrial water rights applications, filings, and federal options for water use in some eastern Montana river basins and reservoirs.

These data indicate that over 3.3 million acre-feet of eastern Montana water is being contemplated for usein future coal development. Although not all of this water will eventually be used for energy development it does indicate the large magnitude of potential development of conversion facilities planned for eastern Montana.

A survey of over 100 energy-related companies taken by the Department of Natural Resources and Conservation recently pointed out that nine companies indicate plans to develop fifteen different energy conversion facilities in Montana (14).

A Federal Energy Administration contract has been awarded to the MHD Research and Development Institute at Montana Tech to conduct a feasibility study of turning the abandoned former Glasgow air base into a federal energy park which would include strip mines, electric power, coal gasification, and liquefaction plants. Although part of a national program to investigate the potential for converting approximately eight abandoned military bases into energy parks (7), the Glasgow base's promimity to vast lignite reserves and water from the Upper Missouri River Basin and Fort Peck Reservoir would seem to make it an ideal site for future energy development.

The Project Independence separate Task Force Reports on Coal, Synthetic Fuels, and Nuclear also identify the northern great plains region as an ideal site for many of the conversion facilities projected for the next 25 years. Of the 74 synthetic natural gas facilities required nationwide by the year 2000 in the accelerated development scenario (23), the NGPRP designates the northern great plains region as supplying 41 (17). Since Montana contains almost half the coal reserves in this study area it seems fair to assume that we can expect pressure for siting about 20 gasification plants by the year 2000.

Table II*
Water Applications
(Acre-feet Per Year)

Location	Total
Yellowstone River Main Stream	643,240
Tongue River Basin	333,400
Bighorn River Basin Inc. Yellowtail Reservoir	1,215,000
Powder River Basin	547,430
Fort Peck Reservoir	585,000
	3,324,070

*Sources: (14) (18)

The Synthetic Fuels From Coal Task Force Report also calls for 54 plants nationwide producing liquid fuels from coal by the year 2000 (23). If the above developed ratio of Montana supplying roughly one-fourth of the gasification plants holds as well for liquefaction facilities we can expect proposals for development of 10 to 15 such plants.

The NGPRP report foresees the need by the year 2000 for 12,800 megawatts of additional electricalpower generation in the six-state study area under both the most probable and extensive development scenarios (17). This is equal to 18 plants the size of Colstrip 3 and Montana may well be pressured to site a number of these.

Uranium enrichment facilities will be required to fuel anticipated additions to the nation's stock of nuclear power plants. Depending upon projections, anywhere from 12 to 18 will be required by the year 2000 (4), each needing an electricalpower supply of 2400 megawatts. Montana is a prime site for these plants due to its vast coal reserves and the ease of mine mouth electrical power generation to supply their electricity requirements.

Whether these facilities will ever be built in Montana depends upon many factors, the most important of which are the future availability and price of natural gas and oil, the future demand for electricity, the rate at which nuclear power plants come on line, the availability and competing demands for water in eastern Montana, state policies toward in-state energy development, and federal policies regarding the role of coal and the northern great plains in the national energy supply picture.

There are certainly many complex issues surrounding these variables. Their resolution will not come easily, nor will it come quickly. However, at this early date we can see some indications of an emerging national energy policy, and they all point to an accelerated development of our nation's energy supply options with the northern great plains certainly providing its share of energy sources through coal development.

Evidence of this can be found in President Ford's State of the Union message in which he announced the energy policy option of accelerated supply and marginally reducing energy demand so that the nation could eliminate energy imports by 1985, and then export energy by the year 2000. In his own words this would require the construction of the following energy projects by 1985: 200 major nuclear plants; 250 major new coal mines; 150 major coal-fired power plants; 30 new oil refineries; 20 major new synthetic fuel plants; and the drilling of thousands of new offshore oil wells. This sounds very similar to the Project Independence accelerated development option and would require a new nuclear plant every two and one half weeks and a new coal mine every two weeks.

In a move which apparently lends political and administrative support to this energy development scenario President Ford recently announced his nomination of former Wyoming Governor Stanley Hathaway as Secretary of Interior. Although supported by some western governors, Hathaway, while Governor of Wyoming, encouraged full scale development of his state's energy resources, including nuclear and oil shale development. From past actions it is clear that Hathaway would lend key support to the administration's pronouncements for accelerated development of the northern great plains energy resources.

Obviously this means that our coal resources will be mined. The President has publicly called for a doubling of national coal production by 1985 and close examination of the Project Independence Coal Task Force Report reveals that this projection slightly exceeds its business-as-usual forecast for coal production. However, while this forecast calls for a doubling of coal production nationwide it also reveals that the northern great plains is expected to produce almost an eight-fold increase in production by 1985 over that occurring in 1972 (22).

On April 9 the director of the Interior Department's Bureau of Mines cited the goal of doubling coal production by 1985 in the context that "coal must be the predominant energy mineral of today and of the immediate future. It is the only one with the potential for a significantly larger role by 1990. Coal will buy us the time we need..." (6).

Executive branch intentions regarding energy facilities planning are becoming more clear now that the Energy Facilities Planning and Development bill has been sent to Congress. This proposed legislation reflects the real sense of urgency in the administration over the need to expedite the processing of power plants and bring them on line to achieve energy self-sufficiency at the earliest possible date. The bill would require each state to prepare its own program for siting conversion facilities subject to the approval of the Federal Energy Administration. If the proposed program was inconsistent with federal guidelines the FEA could override the state's wishes and require revisions (5). The implications of this type of legislation are far-reaching indeed and would render state laws governing energy facilities powerless.

The tug-of-war between Montana, the federal government, and industry over our state's energy future is barely beginning. Early understanding of what will be expected of us is critical to whatever success Montana may have in determining its own energy future.

THE MONTANA RESPONSE: DIMENSIONS OF THE ISSUES

Today Montanans must clearly identify the basic issues of this emotional debate over energy development. Two principal questions are: Must, or should, our coal be strip mined to supply power to other parts of the country? and, if the coal is mined should coal conversion facilities be sited in Montana at the mine mouth or out of state at the load center, where the energy is demanded?

It may not be politically realistic to assume that Montanans can exert much influence over the firt issue. The extent to which our coal is mined for export out of state will depend primarily upon federal coal leasing policy, pending strip mining legislation and its provisions and its provisions regarding private surface owners, the speed with which industry moves to sign long-term contracts and develop its Montana lease holdings and the willingness of surface owners to sell their mineral rights.

It should be pointed out, though, that under Montana's current reclamation law applications for strip mining permits can be denied if reclamation cannot be carried out consistent with the purposes of the act.

Reclamation of our arid valleys and plains has not been proven. Recently the Agricultural Experiment Station at MSU in Bozeman stated that, after seven years of study, there is no scientific evidence that Montana's reclamation laws can be complied with. Eastern Montana's self-sustaining rangeland cannot be replaced under "abandoned" conditions, which means in the absence of artifical fertilizers and/or irrigation (26). It would appear that either of these requirements would be economically unjustifiable from a private farmer or rancher's standpoint. the potential for reclaiming mined lands is much greater in wetter midwest coal producing areas.

We certainly can also attempt to influence federal leasing policy by pointing out other facts concerning the pending shift in coal mining from east to west.

The westward coal shift will result in well-documented socio-economic disruptions, both in the east due to reduced potential mining activity, and in the west where a rural way of life will be slowly displaced by the energy industry.

There is some dispute over the necessity of going west for the low-sulfur coal required for power plants to burn to meet the federal new-source performance standards. Seventy-five billion tons of low-sulfur coal are still recoverable in Kentucky, West Virginia and Virginia, two billion of which are easily surface minable (3). Also, a Sierra Club research team has recently pointed out that analysis of Fort Union coal samples indicates that much of them when burned in the absence of scrubbers exceed the new EPA emission limits of 1.2 pounds of sulfur per million BTUs produced (1).

Proponents of utilizing low-sulfur western coal usually put forth the argument that it results in lower costs to the consumer of electric power since it is cheap to mine and doesn't require the installation of scrubbers. It must be pointed out that this cost advantage is dependent upon two critical variables; the cost of transportation and the cost of scrubbers. Should either the former rise or the latter fall the cost in advantage of our coal in its current markets, the northern midwest, midwest, and south will be seriously affected.

Some preliminary work I did on a net energy analysis of this coal shift also raises serious long-run questions about its desirability. Simply stated, net energy is the energy liberated by an activity minus the energy expended in all steps comprising the activity. It is becoming increasingly evident that any energy policy developed on a national or state level must pay close heed to this net energy concept for it is obvious that once we have honestly defined future energy needs we must seriously attempt to meet these BTU requirements at the least BTU cost.

The complete methodology for my analysis is contained in Appendix C of the Montana Energy Policy Study. I assumed a typical Montana mine producing 8,500 BTUs per pound of coal and compared it with West Virginia surface and underground mines producing 13,200 BTUs per pound of coal. Estimates of BTUs consumed during production and reclamation were based on most recent cost data and an energy input-output equivalent of 67,456 BTUs per dollar (9). Transportation was assumed to be by rail to a common burn site in Illinois. BTUs consumed during transportation are based upon direct fuel consumption data.

Table III shows the ratio of BTUs produced per each BTU consumed for the three supply options; 36.1:1 for eastern surface mined, 32.8:1 for eastern underground mined, and 19.6:1 for Montana coal. Extending this analysis shows that delivering 50 million tons of Montana coal consumes 19.9×10^{12} more BTUs, the equivalent of 1.2 million tons of Montana coal, than would be consumed in delivering the BTU equivalent of eastern strip mined coal. Restating this conclusion another way, 85 percent more BTUs will be consumed in delivering Montana coal to an Illinois burn site than the BTU equivalent of West Virginia Coal.

If reclamation in the west requires moreenergy inputs than currently believed, or if expanded transportation facilities eventually are required, the significant net energy advantage of eastern coal will increase.

Although this particular analysis is limited in application many other potential combinations of mine sites and power plants can be analyzed in this framework.

The siting of conversion facilities in-state or at the load center requires that Montanans look closely at five important

Table III
Net Energy Analysis of Delivering Montana And West Virginia Coal To Illinois Burn Site

Mine Location	BTUs Produced Per Million Tons	BTUs Consumed* Per Million Tons	Ratio BTUs Produced BTUs Consumed
West Virginia			
-Surface	26.4×10^{12}	73×10^{10}	36.2/1
-Underground	26.4×10^{12}	80.4×10^{10}	32.8/1
Montana	17×10^{12}	86.9×10^{10}	19.6/1

*In Production, Reclamation, and Transportation

variables in addition to net energy: environmental degradation, socio-economic impact, jobs, energy cost to the consumer, and water availability.

The air and water pollution resulting from coal conversion plants has been well documented. Suffice it to say that there is something absurd in proposing to degrade the west's pure environment on the grounds that our country's load centers are already so polluted that we can ill afford to pollute there any more.

The socio-economic impact already felt from Colstrip 1 and 2 attests to what the sparsely populated regions of eastern Montana may come to expect from the construction of further energy conversion facilities. Extensive analyses of what has happened in Rock Springs and Gillette, Wyoming as a result of the construction and operation of conversion facilities show the same affects experienced at Colstrip: school overcrowding, a scarcity of adequate housing, disruption of the agricultural sector of the economy, higher prices, labor shortages, increased crime rates, inadequate health care, overloaded water supply and sewage systems, and deterioration of roads and highways.

Our analysis shows that permanent population increases from the operation of, for example, seven gasification plants, three liquefaction plants, and one uranium enrichment facility would be over 45,000 people, not including those associated with the mining activity itself. About 11,000 school age children would need school space, and between 13,000 and 18,000 new residences would be required. The construction phases of these facilities would generate a population increase of over 130,000. Obviously if the infrastructure required to support these population increases is available at the load centers the socio-economic disruptions and expenses for mitigative measures would be minimal should the power generation take place there instead of Montana.

The job impacts of expanded coal shipment by rail out of state and how they compare with jobs generated from mine mouth facilities is little understood. A recent report prepared for the Montana Department of Public Service Regulation concluded that almost three times the number of direct operating jobs would be generated by westbound unit train shipment of coal as opposed to those required to operate the Colstrip 3 and 4 generation and transmission facilities (21). They would also be distributed more equitably, throughout the state rather than in a single locale. More work is required on potential jobs created by coal shipments east and expanded rail facilities compared with those produced at conversion facilities.

A net energy analysis points out that load center electrical power generation delivers more net energy than mine mouth generation. Table IV compares energy consumption/loss for rail, slurry pipeline, and EHV transmission alternatives for shipping coal or its power equivalent. These figures show that EHV transmission consumes about three to three and one half times the energy that rail shipment does and about nine times that for slurry pipelines. Research needs to be done on the energy required to pipe synthetic natural gas as well as liquefied petroleum products and how this compares to slurrying the coal equivalent.

Table IV*
Energy Consumption/Loss of
Various Transportation Alternatives
(7 Million Tons of Coal Per Year or its Power Equivalent)

Type	BTUs Per 100 Miles
EHV Transmission	1400×10^9
Rail	$380 - 447 \times 10^9$
Slurry	160×10^9

*Sources: (2) (19) (20) (21) (25)

We should also take account of the qualitative difference between the types of energy consumed. Diesel fuel can be considered a more scarce energy resource than the electrical energy lost during transmission therefore it could be subject to more stringent conservation requirements. Of course a more thorough analysis would consider the energy required to build the pipelines, transmission facilities, and the needed additional unit trains.

Energy costs to the consumer can be significantly lowered by shipping coal to the load center rather than converting it to electricity at the mine mouth. As Table V indicates, data developed by Malinda Schaill at the University of Montana show that exporting the coal equivalent of Colstrip 3 and 4 power generation to the Spokane area by rail is 12 to 20 percent less expensive to the consumer than transmitting the high voltage electricity. Total savings to the customer over the 37 year expected life of the plant averaged between $2.8 million and $13.7 million per year, depending upon assumptions surrounding the interest rate and investment total (11).

Other research on costs of transmitting power show that rail costs are 20 to 50 percent less than transmitting the power equivalent of the coal, and that costs of slurrying the coal mixture are even less than rail, up to a 50 percent saving again with very large quantities over long distances.

Table V*
Costs Per Ton-Mile or Power Equivalent
For Various Transportation Alternatives

Type	Cents
Colstrip-Spokane	
EHV Transmission	1.08 - 1.2
Rail	.95
General	
EHV Transmission	.94 - 1.25
Rail	.58 - .77
Slurry	.32 - .6

*Sources: (2) (11) (17) (21)

The cost escalation factor needs to be considered in this analysis. Due to the capital intensive nature of both transmission lines and pipelines their costs may escalate less rapidly than rail charges (2). This area needs more research as does the question of costs to consumers of mine mouth or load center gasification and liquefaction facilities.

No mention yet has been made of the public need for these proposed facilities. Perhaps we have assumed for too long that they would not be constructed if there were no ready market for their products. Although Montana's Utility Siting Act requires that the public need be demonstrated before a permit can be issued, much controversy can be generated when arriving at estimates of "public need."

This issue is particularly germane when one considers building gasification or liquefaction facilities since their products will be priced higher than those prices currently being charged or anticipated, thereby significantly increasing costs to the consumer. Many experts still report conflicting opinions about the size of our natural gas and petroleum reserves at different wellhead prices, and how long these reserves will last at various future consumption rates. Although we have heardof the looming natural gas shortage, as recently as last summer Exxon Corporation estimated that at a wellhead price of 70 cents mcf, enough natural gas could be recovered to supply current rates of demand for 70 years (10). If this were indeed the case there would be no immediate need for gasification facilities.

Water availability is perhaps the most critical of the variables, not only because eastern Montana's present livelihood is very much dependent upon its scarce water resources, but also because the water issue is emotional, economically and legally complex, and ill-defined.

A concise statement of future water demands and availability in the Upper Missouri and Yellowstone River Basins will have to await further research and legal and political developments. However, at this time it is fair to state that, at least for the

Yellowstone River Basin, future water supplies, even with extensive damming, will be unable to meet both energy and irrigation needs.

Best estimates today of water requirements for energy development in Montana range from about 200,000 acre-feet per year (afy) by the year 2000 to about 700,000 afy by the same year. This excludes water requirements for land reclamation and associated population increases, Table VI shows the derivations of these estimates.

Present plans show that almost 165,000 additional acres will be irregated in the Yellowstone River Basin by 1985 (12). Based on projections for increased red meat production, the Montana Department of Natural Resources has estimated that 630,500 new irrigated acres will be required in this basin by the year 2000 (14). Applying the most recent cropping patterns and a per acre diversion requirement of three afy per acre shows that these acreages will require 500,000 afy and 1.9 million afy of water respectively.

Table VI*
Water Requirements for Energy Development
In Montana By the Year 2000

Department of Interior	Most Probable	Extensive
	189,000 afy	361,000 afy

Project Independence
(Derived from
Accelerated Scenario)

20 Gasification @ 10,000 afy = 200,000 afy
10 Liquefaction @ 40,000 afy = 400,000 afy
1 uranium enrichment and
associated power @ 67,000 afy = 67,000 afy
2400 MW of additional power @ 45,000 = 45,000 afy
Total 712,000 afy

*Sources: (4) (22) (23) (24) afy=acre-feet/year.

The Montana Department of Fish and Game has also requested flow reservations of millions of acre-feet of water in the Yellowstone to maintain in-stream flows.

Although final determinations of the amount of water available to Montana in the Yellowstone River Basin are still to be made it is obvious that the quantity will be insufficient to satisfy all projected water demands and still maintain some in-stream flows, even with extensive damming and aqueduct systems. Maximum water demands could exceed 2 million acre-feet by the year 2000 and even 600,000 acre feet by 1985. Our analysis indicates that the maximum amount of water available for allocation in the Yellowstone Basin while maintaining some in-stream flows would be about 1.2 million acre-feet with extensive damming. Damming these free flowing waters is itself an emotional issue which has already sparked much heated debate.

The Upper Missouri River Basin, including the federally owned Fort Peck waters, obviously could supply much of these potential water needs in eastern Montana. Fort Peck water reservation requests indicate industry's awareness of this. More research needs to be done regarding the availability of these waters, both with and without additional damming and aqueduct systems, in anticipation of their future value as constraints on the Yellowstone Basin waters are confirmed.

Although these consumption demands don't appear to conflict until at least 1985, policy decisions must be made soon to designate future allocation rights and resolve far reaching legal issues. Montanans must continue to watch these unfolding policy developments closely, because their emphasis either for or against energy development will determine for many years to come the sociological, environmental, political, and economic climate of eastern Montana.

SUGGESTED POLICY OPTIONS AND IMPLEMENTATION

I have attempted to summarize what uncontrolled energy development may mean to Montana and define a framework within which energy development can be analyzed. However, this is not enough. Our Montana Energy Policy Study concludes that Montana must act today to guide future energy development and provide reasonable limits on conversion facilities so that the long-range best interest of all Montanans can be served. It also concludes that existing state policy is inadequate to assure our future economic stability, agricultural growth, and environmental quality.

This is not simply a question of being for or against growth in the development of our finite energy resources. It is a matter of defining those policy initiatives currently available to us in order to determine our own future before the federal government or the energy conglomerates do our long-range planning for us. We must also remain cognizant of the fact that the best way to assure long-run self-determination is to preserve our future options. Evidently if agricultural development or energy development were identified as imminent tradeoffs agriculture should be the priority for no other reason than it is a renewable economic activity necessary to the basic well-being of all people.

It cannot be overlooked that a prerequisite for any effective state action is an informed citizenry, for without enlightened public understanding of the issues and available alternatives, and public support, no enduring political action can be taken.

Policy implementation will depend upon whether the state has legal or administrative control over the decisions to be affected. Until now Montana has exerted legislative authority in four critical areas: the Montana Environmental Policy Act, acts governing reclamation and utility siting, and the Yellowstone water moratorium. Judicious enforcement of existing laws such as these are imperative; the public should closely monitor administrative decisions being made subject to these laws and require strengthening of these laws if new energy developments require it.

In addition to policy research and suggestions made elsewhere in this report, the following items list some basic areas where the state can and should take a stronger legal or administrative role:

1. Explore and establish financial incentives to encourage the conservation of energy.

2. Establish environmentally sound controls over uranium mining, milling, and processing.

3. Discourage inefficient consumption of electricity and natural gas by disallowing public utilities the use of the declining block rate pricing structure.

4. Closely monitor the future availability to the state of natural gas and petroleum, both from in-state and out-of-state.

5. Clearly explore the legal, economic, environmental, and social ramifications of an export-only policy for our coal resources.

However, we must not be deceived into thinking that state actions alone can exert adequate control over our energy future. Ultimate control lies with the federal government; it is clear that with its legal authority it can effectively override, if it desires, every decision, legal and otherwise, that we in Montana wish to make.

Besides the Energy Siting Bill proposed by the President there is currently a bill introduced in the House, HR2220, to give the power of eminent domain to builders of slurry pipelines. Even though the use of water for slurries is not a beneficial use under the Montana Water Use Act, if this bill were passed the siting process for slurries in this state using federal water, such as that in Fort Peck, would be obviously expedited. This could significantly increase the demand for our coal because of the expanded market area resulting from previously cited savings in the cost of transportation. For these reasons we must also focus our policy efforts on Washington, D. C.

We must take all steps available to influence the emerging national energy program by establishing a clear state policy and then recommending to the federal government actions consistent with this policy.

Our analysis of the wide range of federal energy options shows that accelerated development of energy supply as envisaged by the Federal Energy Administration (FEA), would be unacceptable to Montana due to environmental consequences, water constraints, and socio-economic disruptions. There are also serious technical, economic, and material availability constraints associated with this scenario.

Also our future options, as a state and a nation, will be minimized if we proceed to rapidly develop our finite energy resources. It is in all our interests to stretch out the life expectancy of these valuable resources.

Although a thorough analysis of all available federal options was beyond the scope of our study and must await further research, it is obvious that at a minimum we must ask the federal government to enact a comprehensive energy conservation program aimed at achieving an average energy growth rate of 2 percent per year through the year 2000. Recent research implies that there is no effective relationship between economic growth and energy consumption and that the second can be reduced while maintaining the former. Last month the prestigious Conference Board concluded that the U.S. could significantly cut its energy consumption to an annual rate of 1.5 percent without damaging the economy.

An emerging conservation consensus is forming, not solely limited to the Ford Foundation's Energy Policy Project. The President's Council on Environmental Quality has urged adherence to a 1.8 percent per year rate of energy consumption, the FEA has concluded that a 2 percent growth rate could be achieved; and the Committee for Economic Development, composed of 200 leading businessmen and educators, last December advocated a growth target of 2.9 percent per year (8).

There no longer appears to be any logical rationale for refusing to adopt national energy growth rates of this magnitude. In addition to forestalling depletion of our gas, oil and coal resources this policy option would result in lower per unit prices for energy than the accelerated development scenario, retain today's level of energy services, provide for economic stability, and maintain our nation's environmental quality.

If the federal government were to adopt such a conservation policy Montana should then work closely in supplying future energy needs to the nation. Further national policy initiatives, however, should encompass certain criteria recognizing that state government, because of its close relationship to the people, can more effectively guide in-state energy development than the federal government.

These criteria are:

1. All regions of the nation shall supply a just proportion of future energy needs.

2. Federal regulation and legislation for supplying the nation's energy needs shall incorporate state energy policies.

3. States shall be integrally involved in all phases of energy planning within their borders.

4. States should control the siting of energy facilities within their borders.

5. Development of energy supplies must be based upon the most favorable net energy delivery.

6. State air and water environment quality standards must be met.

7. Surface mining of energy resources must take place only in areas where reclamation is proven.

8. Water availability for future agricultural growth and to maintain in-stream flow must not be limited by premature appropriations for industrial use. Agriculture must be given the highest priority for future water appropriations.

Ultimately the decisions of how hard to push domestic energy production and where it will occur will be political in nature and national in scope. How can a state or region with a small percentage of the nation's population make its voice heard in the face of competing demands of more populous regions with perhaps more political influence?

As a first step it is absolutely essential that states of this region act together to enact such policies. States should, to the extent possible, pass similar legislation controlling and regulating water and energy development so that industry cannot play off one state against another. The states should speak with a single voice to their U.S. senators since these senators could have a proportionally significant influence on federal legislation.

The recently established Western Governor's Regional Energy Policy Office could also carry some political influence; however, there must be some question at this point as to whether all 10 governors can agree on any policies of consequence given the indicated level of control they wish to exert over the office. There must also be a coherent and consistent means of public input into the office for it to have any degree of long-range effectiveness and validity.

There are a number of other activities closer at hand that we should all be kept apprised of if we want our voices to be heard. State legislation has been passed expanding the Utility Siting Act, providing incentives for conservation, and requiring the governor to prepare a further energy policy study for presentation to the 1977 legislature. The Environmental Quality Council will be reprinting its Montana Energy Policy Study for distribution and will pursue other research efforts relating to natural gas availability and water. The Montana Energy Advisory Council, chaired by Lt. Governor Bill Christiansen, will be renewed for another two year period and will expand its research capability and role as the coordinator of our emerging state energy policy. The Department of Natural Resources (DNR) will present the results of its two-year study on future water supply and demand in the Yellowstone Basin, with recommendations for a comprehensive water plan to the 1977 legislature. The DNR has also intervened in an Environmental Defense Fund suit questioning the legality of Bureau of Reclamation industrial water allocations out of Federal reservoirs, such as the Yellowtail Dam. Our Utility Siting Act is being administratively and legally tested by the Colstrip 3 and 4 debate and associated Department of Health recent statements about those facilities affect on air and water quality. Our state Public Service

Commission has expressed its interest in thoroughly reviewing our natural gas and electricity pricing structures.

Decisions made in the next five years could irretrievably alter the face of eastern Montana, and deeply affect western Montana as well. We cannot, by our inaction, allow outside interests to dictate our energy planning for us. The apparently proposed extensive development of the northern great plains energy resources is a symptom of poor energy planning and policy and the ultimate effect of this policy could very well prove as detrimental to the nation as it threatens to be to this region.

We all have a deep responsibility to remain well-informed on the issue of Montana energy development, and to speak up for what we perceive to be in the best interests of the state. It may not only be that the welfare of future generations of Montanans will depend on us, but that perhaps the country as a whole is also searching for some guidance on this most critical problem, and that our efforts may serve the long-run interests of the nation as well.

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THE RIGHT TO PARTICIPATE: ATTITUDES REGARDING LAND USE AND DEVELOPMENT IN SOUTHEASTERN MONTANA

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INTRODUCTION

The development of land and energy resources has been subject to public scrutiny since private ownership of real estate became possible for most persons. Although the form of most development has been largely determined by free market principles, such principles have gradually become mediated through legislation intended to serve the commonweal. Recent important examples of legislation intended to optimize the benefits and costs of land use and resource development include the National Environmental Protection Act (NEPA) and the Montana Environmental Protection Act (MEPA). These and similar pieces of legislation were written with the intent of providing legal mechanism for facilitating warranted exploitation of land and natural resources while protecting the interests of all relevant parties.

Despite an earnest attempt to direct implementors of legislation in the mechanisms of implementation, much legislation often falls short of its goal. In part, omissions are the result of failure to anticipate all potential uses or requirements of the legislation. No one is born with a crystal ball. In order to avoid unnecessarily long or restrictively precise documents, persons drafting MEPA and NEPA opted for documents of considerable breadth and depth which retained sufficient flexibility to respond to specific problems encountered with the legislation.

The object of this paper is to describe and illustrate one set of problems associated with the implementation of these pieces of legislation. That is, social impact statements are now required by law before developments having potentially significant social impacts may be carried out.

The Declaration of Policy for the act reads, "It is the purpose of this act to produce an understanding of the Nation's natural resources and the environmental forces affecting them, to promote and foster means and measures which will prevent or effectively reduce any adverse effects on the quality of the environment in the management and development of the Nation's natural resources, and to create national policy and conditions under which man and nature can exist in productive harmony and fulfill the social, economic, and other requirements of present and future generations of Americans through a comprehensive and continuance program of study, research, review, and coordination." (7).

A first and most immediate problem centers around what constitutes a significant change. Second, and perhaps a more difficult question emerges around what defines the appropriateness or adequacy of information determining potential social impacts.

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These issues are addressed in each policy act.

"To document and define changes in the natural environment."(7)

"To initiate and utilize ecological information in the planning and development of resource-oriented projects."(7)

"Representative samples of important natural environmental systems, including natural areas for observation and for manipulation."(7)

Directs that an EIS must cover "Environmental Impacts, primary and secondary, beneficial and adverse."(5)

And, "Relationship between local short-term uses of the environment and maintenance and enhancement of long-term productivity."(5)

A third question relates to how such information is to be used by decision makers determining the fate of the development. This paper will focus upon the last two questions by drawing upon materials collected in the Fort Union Coal region. Two hundred and fifty-nine respondents were interviewed from a potential respondent list of 288 households in the Decker-Birney Study Area.

Data analysis proceeded through several phases. Upon completion of keypunching and verifying, information was transferred to disks. Information was then processed through data cleaning programs to eliminate any errors yet undetected. Summaries of responses and descriptive statistics (mean, median, mode percentage, standard deviation, variance etc.) were then run for responses to each question. Response categories were then recoded where appropriate in order to assure valid categories as well as sufficient cases per category to perform subsequent statistics.

Since information was collected from a population, rather a sample of population, the decision was made to compute measures of association rather than tests of significance.(1) That is, the statistics reported are statements of the strength of relationship between particular variables rather than statements expressing the probability of that repondents reliably reflect the rest of persons in the area.(2) The primary measure of association utilized for this purpose is gamma (γ), an ordinal statistic which has the characteristic of permitting a proportional reduction of error interpretation.(3) The higher the statistic, the stronger the association between the variables being analyzed.

Generalizations concerning population attitudes are usually rather difficult to make. In the case of Decker-Birney area residents, however, generalizations regarding satisfaction with the area easily can be summarized. Most persons in the Decker-Birney area appear to be satisfied with the area (c.83%) and with their life quality in the area (c.80%). As a population, they are strongly opposed to coal strip mining (c.83%) and attendant coal development (c.65%). Still, their feelings regarding planning and development are much more diverse and complicated than are their feelings of satisfaction. Acknowledging poor quality of such items as local roads and medical facilities, most respondents favored the improvement of many facilities, services, and opportunities by strongly opposed coal as a means toward bringing them to the area. Most persons (c.62%) were ignorant of any areawide planning attempts. Moreover, a minority (c.27%) favor the principle of an areawide plan with most others (c.54%) taking a wait-and-see position. If a plan was developed, respondents feel local persons should develop it (c.71%), although only a few (18.4%) feel the local residents will develop a plan.

Generalizations by themselves are often misleading and certainly not entirely revealing. Distinct differences occur when different sub-categories are considered. In fact, some differences in feelings about development and planning occur between all sub-categories. For purposes of brevity only, the strongest categorical differences which emerged from the research will be presented here.

The three most important characteristics in the Decker-Birney area were number of years resided in the area, occupation and where respondents lived, i.e., rural versus town. The differences occuring among respondents in different categories are reported in the following section.

WHERE RESPONDENTS CURRENTLY RESIDE

During the process of interviewing one of the most evident differences among respondents was where they lived, i.e., in the rural area or in Ashland. The most obvious socio-demographic differences were in their occupations. Rural dwellers were most likely to be ranchers (83.3%) whereas townspeople were almost equally divided among the private section (33.7%) operators and construction (32.7%) and the public sector (28.6%) (γ =.35). Differences also were evident in the sex respondents. Forty percent of town respondents were men whereas 41% of rural respondents were women (γ =-.37).

Recent arrivals (γ.53), younger persons also seemed more frequent in town than in the country. The data indicate 26.8% of town dwellers and 15.7% of rural dwellers are in the youngest age group (17 - 29). In the country 28.3% of the respondents are over sixty years old compared to 15.5% in town (γ=.24).

In spite of considerable attachment to the Decker-Birney area, townspeople, as a category, are relatively less embedded than are rural persons. Nearly every measure of attachment -- amount of time lived in the area, being a native of the area, having rural and Montana heritage, plans against moving --indicate rural dwellers tend to have greater attachment and more permanent involvement than do townspeople. Certainly, Ashland is among the most remote type of town envisioned by most urban dwellers. Still residents of Ashland in many ways are different in how they see themselves, and are seen by rural residents. Townspeople, however attached to their town, probably are less threatened by social change than are country dwellers, especially in an area so remote as the Decker-Birney area. After all, as was repeatedly pointed out by ranchers, there are many towns to live in and most persons choose to live in them. But, there are relatively few good undeveloped ranch areas left and the Decker-Birney area is one of them. They conveyed a sense of impending loss which was less frequent among townspeople. These impressions, reflecting the inclusive nature of involvement of rural dwellers with the area are continually demonstrated through their responses.

Rural residents are less likely to see changes in the area as improvements (γ=-.29). In congruence with their opposition to change, rural dwellers also express suspicion of potential agents of change. They more frequently feel industrial interests in the area are too powerful (γ=.46) and would like a moratorium to be placed on leasing of state and federal coal lands (γ=.25). They also more strongly favor a moratorium on power plants (γ=.30), new strip mines (γ=.35) and transmission lines (γ=.38. They feel industrialization within the area will upset the community (γ=.53). For example, over one-half of the rural respondents have noticed a shift in power from ranchers to the coal industry (γ=.24). Townspeople, on the other hand, see a shift in power from themselves to ranchers (γ=.50).

Despite their opposition to development, rural dwellers also oppose potential advice from federal planners (γ=-.92). Moreover, they more strongly (67.7%) support the right of land owners to develop resources if they wish (γ=.37). They (67.8%) generally do not favor professional planners in the area (γ=-.49) and they more frequently feel their friends (γ=-.34) feel the same way. More of them (22.4%) would sign a petition opposing a comprehensive plan, though many more respondents, rural and town alike, are uncertain how they would respond (γ=-.33). 91.3% of rural dwellers feel the people living in the study area need a strong voice (γ=.34).

Nearly 70 percent of rural residents feel local residents should decide the adequacy of any plan and only 11.8% feel state or federal governments should decide (γ=.28). Personal benefit does not seem to be the key factor involved in feeling toward planning. In fact, relatively few rural residents (26.7%) feel they would be harmed by a comprehensive plan.

Rural dwellers resist coal development from a wide variety of perspectives. They do not feel Montana coal should be mined merely because the federal government says it is necessary to meet energy needs (γ=.27). While most respondents (71.4%) feel the nation needs Montana coal, rural dwellers disagree it should be developed (γ=.41). Most rural dwellers fear development will mean dammed rivers (γ=.24) and most feel there are already enough strip mines in Montana (γ=.23). They most heavily favor no more mining and rarely favor local generating plants (γ=.30). Only few (6.8%) feel an obligation to generate electricity (γ=.48) or to develop more industry for Montana (γ=.55).

Some of the opposition to coal development expressed by rural persons may rest with a greater apprehension regarding outsiders. More of them feel miners do not adapt like the local residents (γ=.23). They more frequently report that construction workers have different values from local residents (γ=.37). They (76.4%) feel, even more frequently than townspeople (67.3%)

that clean air can not be sacrificed in order to create industrial jobs. Moreover, rural dwellers are less likely to want to move in spite of opposition to coal (γ=.34) even though they expect coal development and population influx to affect their family ties (γ=.50) and to affect area residents (γ=.49). In fact, a majority, especially strong among rural dwellers (83.2%), agree development will benefit outsiders more than themselves (γ=.48).

Most persons in the study area are concerned with coal development and planning for their futures. Rural persons are more likely to have learned of planning efforts from personal contacts or written media (77.3%) while townspeople more frequently learned through radio, television or some other source (63.2%). Most respondents, but especially rural dwellers (77.0%) feel outsiders (to the study area) are poorly informed about coal development (γ=.22), although a minority of residents, especially townspeople had not heard that as many as seven generating plants had been proposed for the area (γ=.54).

In spite of considerable opposition to planning by state and federal representatives, local residents do have guidelines they would like to use for the future. Most (75%) respondents feel Montana agricultural experts should decide when reclamation has been achieved. Though 14.4% of rural dwellers would prefer land restored to original form and productivity, they (90.7%) feel decisions regarding development should be based on "people reasons" rather than economic ones (γ=.38). However, they (73.9%) agree that current coal company policies are dictated more by law than by feelings for people (γ=-.22). Although most favor equal voting abilities for everyone, a few (6.8%) disagree (γ=.23). They more frequently agree social costs must be considered for any development (γ=.31) and that people like themselves should influence the coal decisions (γ=.52). Most feel strip mining is incompatible with good land use practice (γ=-.37) 67.1% fear crop water will be lost and springs dry up (γ=.59) if mining occurs (γ=.33). They (70.2%) feel area residents will not be better off if strip mining occurs. (γ=.52). They strongly disagree that strip mines will be the best things for Montana (γ=.45). They (87%) see the agricultural productivity of Decker-Birney land as too high to exchange for strip mining (γ=.67) even though they recognize the low sulphur content of the coal (γ=.20). They also strongly disagree (77.6%) that our timber is so poor as to warrant strip mining (γ=.33).

OCCUPATION

Among variables associated with position in the social system probably none is more important nor more frequently studied than occupation. The occupational structure reflects the character of the entire social structure. The Decker-Birney Area clearly exemplifies this relationship. Agricultural occupations, for the most part ranchers and kindred workers, comprise over one-half (53.7%) of the occupations for household heads in the Decker-Birney Area. Persons holding positions in the public sector, businessmen, professionals and managers contribute 17.0% followed closely by head of households in constructions and in the public sector, teachers, Bureau of Land Management, Forest Service, (14.7% each).

Agricultural and public sector persons are more likely to express concern more frequently than construction or public sector persons when many matters are considered. The agriculture and public sectors more frequently feel that industrial interests are too powerful in the area (γ=-.28), that a moratorium on leasing state and federal lands should be extended (γ=-.21), that more power plants should not be built in the area (γ=-.30), that more strip mines should not be developed in the area (γ=-.34), that no rail or power lines should be built in the area (γ=-.24), and that the area should not be the site of generating plants (γ=-.29).

Some of the reasons for this opposition to industrial development more frequently expressed by agricultural and public sectors are: that population influx might negatively influence family ties (γ=-.27), industrialization may upset local decision making (γ=.20) and the community (γ=-.31), that neither the nation (γ=.20) nor the Federal administration does not need Montana coal (γ=.32), that local residents have the right to interfere with coal development (γ=.36), that residents have no duty to generate electricity (γ=.21) or to develop Montana industry (γ=.31), that they should not have to move if area coal develops (γ=.26), that coal decisions are based more on economic than human reasons (γ=.43), that coal companies respond only to the law rather than that the power companies are not really concerned with the environment (γ-.21), that development should not occur just because power companies claim a need for more electricity (γ=.23), for compassion for the people (γ=-.23), that rivers will be dammed following industrialization (γ=-.23), that the area is good timber land (γ=.35), agricultural land and should not be strip mined (γ=.46), that power plants would use water for crops (γ=.27), that springs would dry up (γ=-.47) following strip mining, that strip mining is incompatible with other land uses (γ=.38), that deep mining is more desirable for Eastern Montana (γ=-.20), that recreation land can not be sacrificed for coal development (γ=.29), that claims for reclamation are unbelievable (γ=.28), that ranch operations will be effected by power plants(γ=.4), that area residents would not be better off if strip mines are developed (γ=.39), that strip mines would not be the best for the area (γ=.26) or for Montana (γ=.46), that no more coal development is needed for Montana (γ=-.28), that miners would not adapt like local residents (γ=.31), that social costs have not been considered (γ=-.23). Rather, they see outside areas benefitting from coal development (γ=.21).

In consequence to the general satisfaction expressed regarding the area as it is and general opposition to further development, especially of an industrial nature, persons in the agricultural and public sectors tend to know more and participate more regarding planning than do persons in the private sector and, especially, in construction. Agricultural and Public sector persons more frequently stated that they were aware of efforts for planning in the local area (γ=-.29), found out about these efforts through formal contacts and unspecific means than through friends (γ=.21). However, they had not heard of planning quite as early as had the other sectors (γ=-.27). They feel they should influence coal decisions (γ=.31) although they do not feel they influence development decision making (γ=.26) and do not feel they currently have too much power (γ=.20).

Only a majority of the public sector feels that progress can be stopped, heavily influencing the association (γ=.27) along this dimension.

NUMBER OF YEARS LIVED IN STUDY AREA

The number of years a respondent has lived in the Decker-Birney Area is one of the most important indicators of attachment to the area. The decision to remain in the area is an implicit approval of the location in comparison to other locations. That decision involves more than mere attachment to the physical characteristics of the area. Rather, the environment provides the arena in which family attachments are established, business is transacted, education is obtained and other meaningful activities in life are experienced.(4) Sentiments attached to these activities becomes associated with place in such a way that a place takes on value to persons beyond the desirability of its earth, air and water. A strong association is found between years in area, and feelings related to planning and development of the area.

The broadly based satisfaction expressed by persons who have spent many years in the Decker-Birney Area at times seem to obscure a sensitivity to changes within the area although they are more likely to have noticed changes (γ=.48). Persons who have arrived more recently often seem more aware and feel more strongly about changes than do old timers although old timers feel changes generally had been for the worse (γ=.28). For example, recent arrivals are more likely to feel scenic resources are being destroyed (γ=-.24), that population growth in the area is problematic (γ=-.45). Recent arrivals also more frequently support establishing wilderness areas (γ=-.26) and requiring builders to set aside acreage for public use (γ=-.36).

Consequently, new arrivals express willingness to shut down generating plants polluting beyond acceptable standards (γ=-.21). Over ninety percent of new arrivals feel development decisions should be based on non-economic reasons, a feeling considerably stronger than expressed by the 81% among old timers (γ=-.22). Still, new comers are less suspicious of land reclamation efforts. They (21.8%) feel coal companies have compassion for the land in contrast to the 8.3% of old timers who feel that way (γ=.20). New comers more frequently prefer deep mining to strip mining (γ=.21). They also are far less likely to perceive a serious energy crisis (γ=.25). Old timers feel less in control of inflation (γ=-.28) but more satisfied with life (γ=.29).

Old timers generally appear less likely to acknowledge or to seek to halt changes. Though most (77%) feel scientific knowledge should be used to deal with problems, they are less likely to feel this way than recent arrivals (γ=-.20). Old timers are less favorable toward using state (γ=-.36) or federal planners (γ=-.47) in Montana. They feel more strongly that privately owned resources should be controlled by their owners, (γ=-.21) and that the rate of coal development should be controlled by persons like themselves (γ=-.22). Despite a strong majority (85.4%) supporting the notion of "one man one vote", fewer old timers feel this way than recent arrivals (γ=.37). They further believe that ranch owners are continuing to hold political power more frequently than do the newer arrivals (γ=-.23) and they (81.3%) agree with the way power is distributed (γ=.25).

Feelings expressed regarding planning generally are not associated with years spent in the area. Knowledge regarding plans are sources for that knowledge are essentially the same for all categories by tenure. However, old timers are less likely to have heard of effects of planning (γ=-.48). They also are much more suspicious of planners coming into the area (γ=-.36). And, they feel their close friends (γ=-.25) feel similarly suspicious. Old timers state they would more likely sign petitions to oppose (γ=-.22) and less likely vote for a comprehensive plan (γ=-.31). This suspicion of control is especially directed to outsiders. 76.6% of old timers feel local residents or officials should decide on land use in comparison to 59.3% of recent arrivals who feel that way (γ=.23). Old timers also feel residents should decide reclamation of stripped lands instead of outsiders (γ=.20).

The antipathy expressed by long timers is perceived by them to be in their own self interest. They are less likely to feel potential benefit from a plan (γ=.30). They strongly agree, (83.3%), however, that Decker-Birney Area is good agricultural land and should not be strip-mined (γ=-.27). A small majority (58.3%) of old timers than newcomers (76.9%) feel the national forest in the area are well managed (γ=.24).

The general profiles of respondents according to the number of years residency differ considerably. On the one hand are the more recent arrivals who tend to be more urban and less agricultural than old timers. Newcomers are generally more receptive to planning, especially through implementation of outside authorities. Their feelings tend to reflect greater sensitivity to currently publicized issues of land use planning and environmental policy.

On the other hand are the old timers, many of whom have become integral parts of the social system in the area. They know the persons and love the area. They cherish the control of the area by the persons who reside there. Their greatest concern seems to center around who will make decisions and how those decisions will be made rather than with what decision is made. They are wary of outsiders and wary of controls, even if outsiders and controls might help to protect aspects of the area which they personally value. More than any other category, old timers in the Decker-Birney Area conform to the ethic of individualism so evident in the area. This conformity, expressive of attachment to a particular life style, clearly demonstrates some of the paradoxes associated with values which ultimately prove to be mutually exclusive.

The conclusions to be reached from this data are complex and cannot be fully explored in this brief paper. However, certain summary statements are appropriate. The more time persons have spent in the study area, residing in town and being employed in the private sector and construction are consistently associated with lower opposition coal development than agricultural employment, rural residence and having spent relatively less time in the area. Consistent with this finding is that comprehensive planning is more opposed by the same categories with the exception of agricultural workers who are opposed to planning. However, what controls comprehensive planning differs from this otherwise consistent pattern. Similarly, agricultural workers and persons in construction favor local development of any plan more frequently than do other occupational sectors. his position also is taken by persons who have spent more years in the area and who reside in the country.

Reasons for the relatively low support for planning in spite of general opposition to development presents a paradox. On the one hand most persons report being against development and its negative effects while at the same time express antipathy toward support of a mechanism which might minimize impacts. In part, this paradox may be explained as a failure of many local residents to fully appreciate the potential implications of either development or planning.

CONCLUSION AND RECOMMENDATIONS

Returning to the original issue described at the onset of this paper, it is again necessary to ask, what information is adequate and appropriate for meeting the needs of an environmental impact review? The author maintains that the positions taken on development by the local populace are of critical importance. The distinction man and environment is largely an artifical simplification. In reality men form part of the environment along with the "natural" factors of flora and other fauna. The unique characters of inhabited places, in large part, reflect the imprint of their human inhabitants. Although imprints are most evident in technologically advanced areas they also are evident in sparsely settled spaces inhabited by technologies as primitive as slash and burn agriculture. Mountain climbers report that such remote and uninhabited areas as Mount McKinley even show the residual effects of humanity. More obtusely, such remote places show minimal human induced effects largely because of man-made decisions. That is, even remote areas in national parks retain pristine qualities because of decisions to create and administer such places. In short, the commonly made distinction between man and environment is not founded.

We conclude, therefore, that the human effects within a geographical area form an integral part of the environment. The cultural system exhibited by the inhabitants: their technology for exploiting the geography, their style of life experienced, their rules for living, and all other values, attitudes and behavior, form part of the environment. Certainly this human characteristic must be considered as viable as social patterns among prairie dogs or elk. Moreover, there may be reason to believe that humans may object to having their social world altered or destroyed at least as much as do other inhabitants in the environment. This logic, it seems, is probably that which has lead the administration of the Montana Environmental Protection Act to stress the importance of social factors in environmental impact assessment. The author wishes to emphasize that social impacts involve more than the socio-economic and socio-demographic alterations upon the indigenous population. Alterations in the way of life, interaction systems, i.e., social factors reflecting choice, may constitute the most profound impacts upon the social environment.

The other major issue described in the introduction involves how decision makers are to use information provided them through impact assessment reports. Assuming that the information in the report has some utility, exactly how decision makers will utilize the information is rather unclear. Many decision makers are not familiar with the information presented in reports by specialists in other fields. Correcting communication inadequacies through the use of available specialists, however, still does not eliminate the problems of what to do with the information.

Traditionally, decision makers have decided to develop resources given sufficient common need. One planning text succinctly states, "should local interests conflict with national interests, national interests will need to take precedence." If the existence of the nation is threatened, sacrifices must be made. However, it is questionable whether genuine threats occur as frequently as do sacrifices. Although a few persons would disagree with the logic behind the statement, matters of the extent and timing of exploitation are not addressed. The author suggests, therefore, that local sentiments take precedence over other factors unless crisis is imminent. And, to the extend that crisis is foreseeable, planning should notify and prepare local opposition for inevitable development. A reasonable period of preparation might be the length of a generation--roughly twenty-five years. Given a time of this length, local inhabitants would be able to prepare for change. Adults would be permitted to live out life in the style they had grown to expect. The young, on the other hand, would grow with the knowledge that they can no longer take the style of life for granted if they remain in the potential impact area. They would know that the area would change according to national needs.

Such a lengthy time period, of course, demands a well developed plan. And, given the extensive resources in the United States, not only is such a plan necessary but sufficient delay time is possible. This approach would assure two goals consonant with the desires of most citizens and with the environmental protection acts of both the Federal and the Montana state governments. The protection and prudent use of the resources could occur while protecting the quality of the social and physical environments.

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PROBLEMS AND SOLUTIONS RELATED TO MEASURING REGIONAL ATTITUDES TOWARD COAL DEVELOPMENT AND LIFE STYLES IN THE EASTERN WILLISTON BASIN

David Bickel and Clark Markell*

INTRODUCTION

National and local news releases concerning lignite coal development were prominent news items in the Northern Great Plains during the late summer and fall of 1974. The development of lignite coal promised to be a major factor in the social and economic structure of the region. Plans for increased strip mining and the introduction of coal gasification plants with the potential effects of these on the environment were and are current issues of concern. In 1974 many research teams began moving rapidly to assess the potential impact of this activity on the environment, economy, society and political systems. Most work seemed to be focused on socio-economic phenomena in towns and counties in the region where development was most eminent.

One of the primary objectives of this study was to gather data concerning coal development from the eastern Williston Basin. We also wanted to investigate a procedure for quickly gathering and quantifying a large amount of attitudinal data from a sparsely populated region.

We selected high school seniors as our target population because this group of young adults was about to make important personal decisions concerning their future in the labor market and their relationship to the region. Furthermore, we believed feelings about coal development and career plans to be particularly important within this group because a long-term regional problem has been the exodus of young adults, and the assumption is often made that industrial development will provide career opportunities that will lead to the retention of these people in the area. In addition, we hoped to compare and contrast communities where coal mining has been an on-going activity for many years with representative sample from the entire region.

SAMPLING PROCEDURES

The eastern Williston Basin contains four relatively large population centers, Minot, Williston, Bismarck and Dickinson and there are numerous small towns. Several factors must be considered when selecting representative samples from a large region such as the Williston Basin even when a relatively accessible population such as high school seniors is used. For example, we believe planners and other researchers concerned with social impact need to have the following available:

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1) A measure of the mean attitudes toward coal development and life styles for a representative sample drawn from the entire region. The sample should be representative of the entire population with respect to:

a) sex

b) source of family income

c) size of town, city, or rural area where respondent lives

2) A measure of attitudes among the population by county or other regional sub-unit. This provides baseline data for intra-regional comparisons.

3) Instruments should be designed so they could be used for periodic sampling. Pool (2) stresses the importance of good time series data concerning beliefs, opinions and attitudes in social research.

The population for this study consists of all high school seniors in a twenty-eight county region in western North Dakota. The 1973-74 North Dakota Education Department Directory of Schools was used to estimate the size of the population at 5,468 students. The twenty-eight sampled counties are: Adams, Billings, Bottineau, Bowman, Burke, Burleigh, Divide, Dunn, Emmons, Golden Valley, Grant, Hettinger, Kidder, McHenry, McKenzie, McLean, Mercer, Morton, Mountrail, Oliver, Pierce, Renville, Sheridan, Sioux, Slope, Stark, Ward, and Williams Counties.

The following steps were used to select samples from the population. All schools in the twenty-eight identified counties were listed, and an estimate of the number of seniors in each school was obtained from the listing of school population (grades 9-12) in the 1973-74 North Dakota School Directory. Two of the twenty-eight counties, Slope and Billings, did not have any seniors. Schools with greater than 200 estimated seniors were removed from the list and considered separately. Samples in these schools were drawn from class lists. The remaining smaller schools were grouped according to counties and enough schools randomly selected so at least twenty-five senior class students were drawn from each county.

Ninety-seven percent of the schools randomly selected to participate in the study agreed to administer the survey. Schools from each of the twenty-six counties having high school seniors are represented in the 1500 returned questionnaires. Over 1200 IBM data cards were punched for the county sample and a data check of 572 cards was produced for the representative sample. Analyses of data for each county and the representative sample were carried out with IBM prepared programs on the IBM 1130 computer and resulted in about 1200 pages of printed output.

METHODS

The questionnaire employed during this study was designed by the authors. Questions were written to provide basic background information about students and to measure their preferences for life style and attitudes toward coal development. A variety of question types were used.

Interest in Coal Development

One technique which provided fruitful results involved developing sixteen statements that form a continuum ranging from very positive (supportive) to neutral (not concerned) to very negative statements. The individual then responded by agreeing, disagreeing or expressing uncertainty to each of the sixteen statements. These items were modeled after a basic design used by Remmers in 1960 as described in Shaw and Wright (3). This technique has also been used to measure student attitudes toward a particular subject. Scoring is accomplished by considering only those statements students "agree with" and then determining the median score of items which have been previously weighted. The directions and four of the sixteen items from this portion of the instrument are given below:

> Directions: Please read each of the following statements carefully, Fill in the appropriate blank on the answer sheet as follows:
>
> 1. if you agree with the statement
>
> 2. if you disagree with the statement
>
> 3. if you can not decide about the statement

1. No mater what happens lignite coal development (mines, power plants, and gasification plants) should come first in North Dakota.

5. Coal development (mines, power plants, and gasification plants) in North Dakota is a good thing.

7. I don't believe developing the lignite coal (mines, power plants, and gasification plants) in North Dakota will do anyone any harm.

16. I look forward to the development of the lignite coal in North Dakota with horror.

The Future of North Dakota

In another section of the instrument, students were asked to indicate their predictions about the future of North Dakota. The directions and two sets of questions have been selected as examples:

> Directions: Recently there has been much talk about developing (mining) the lignite coal in North Dakota. Please look at each statement below and decide 1) whether you believe this will happen and 2) how certain you are about your opinion. Place all answers on the sheet.
>
> A. Many new jobs will be created for the people in the State of North Dakota.

B. Relatively few new jobs will be created for the people in North Dakota.

25. Which statement do you believe is closest to the truth?

1. (A)

2. (B)

26. How certain are you?

1. Very certain

2. Fairly certain

3. Not very certain

A. After a region is mined for coal, hunting and fishing will be ruined.

OR

B. After a region is mined for coal, hunting and fishing will be excellent.

29. Which statement do you believe is closest to the truth?

1. (A)

2. (B)

30. How certain are you?

1. Very certain

2. Fairly certain

3. Not very certain

Views about North Dakota

A number of items were also written to determine what students saw as a desirable relationship between their interests, the interests of their state, and national or global concerns. The sum of responses on six continuum questions was used to compute what was tentatively called a "tendency to favor restricted use of North Dakota resources." Respondents could express agreement or disagreement along a scale from 1 to 5, with summed scores ranging from 6 to 30. It is critically important for investigators to be fully aware of their feelings and biases when assigning a name to this score. For example, it is easy to see how someone who either favored development or felt coal development was necessary to preserve the present U.S. or world life style (in terms of energy consumption) might prefer to label this score an "isolation" score and students who "agree"with most of these statements as isolationist. By contrast, it is easy to imagine how a person who feels a strong regional allegiance and/or holds strong conservationist or preservationist beliefs may wish to "disagree" with most statements. Investigators need to write questions which get at the issues while at the same time they also must avoid biased statements and scoring procedures. The reader may wish to test his or her own orientation by reading the following items and then reflecting on the question, "What does a high or low score on these items indicate." The directions and some sample questions from the questionnaire are shown below:

> Directions: Read each of the following statements and decide whether you agree or disagree. Then place the number you have selected on the answer sheet. For example, if you agree with the statement, place the number 5 on the answer sheet.

15. The coal reserves in North Dakota should be used ONLY to produce electricity for the people in North Dakota.

Disagree				Agree
1	2	3	4	5

17. Wheat raised in North Dakota should be used only by people living in the United States, and not sold to Russia and other countries.

Disagree				Agree
1	2	3	4	5

19. Only North Dakotans should be allowed to hunt and fish in North Dakota.

Disagree				Agree
1	2	3	4	5

Background Data

A multiple choice format was used to obtain basic information about the respondents' sex, age, length of time they had lived in North Dakota, and if the family received income from farming, ranching, or mining. Similar questions were also used to determine preferences for residence and occupation.

RESULTS

Students were asked to indicate their years of residency in North Dakota and their years of residency in their school district. They responded by choosing from five time intervals. The representative sample drawn from the entire study area showed that most (over 80%) have been residents of North Dakota 16 years or more, and almost 60% have lived in their present school district at least 16 years. The counties with relatively high population, Burleigh, Morton, Ward, and Williams Counties, have residency times similar to the representative sample. Less populated and relatively rural counties have similar percentages of long-term residents with higher percentages falling within the 11 to 15 year class.

About 44% of the students in the region indicated that their families receive some income from a farm or ranch. County percentages ranged from 18 to 100% of the population indicating some family income from farming or ranching. Of those individuals indicating some family income from agriculture, 70% indicated that their family owns, lives on, and operates their agricultural business, while another 12% indicated ownership and family operation with the family living in a town or small community. Seventeen percent responded that their family derives its farm or ranch income through lease or rental of land to other operators.

When students were asked where they would prefer to live if relocating, approximately 30% selected a farm or ranch, 13% a small town, and 50% in a town or city the size of Minot, Bismarck, or Dickinson. Only 8% of the 572 students preferred a city the size of Chicago or Minneapolis.

When asked about their plans after graduation, 68% indicated they would attend college, trade school, or seek further training of some kind. Only 6% planned to directly enter farming or ranching, 5% were looking toward a job other than farming or ranching, and 5% planned to enter the military service. Eight percent of the students were planning on marriage, or marriage with some career. Most county responses were roughly similar to the regional sample.

Those who indicated plans for post-secondary education were asked to characterize the type of training they were seeking as 1) a four-year degree program, 2) a two-year program, or 3) vocational or technical training. Four hundred and twelve of the 572 students in the representative sample answered this question. Forty percent of these chose a four-year degree program, interest in two year degrees was indicated by 25%, and 27% preferred vocational or technical training. The data demonstrates a strong preference for two and four-year programs. However, when seniors were questioned about the amount of time they felt someone should spend in career or job training, 80% believed two years or less was the appropriate time, and only 20% felt 4 to 6 years would be acceptable.

Five percent of the 572 students in the representative sample had relatives that worked in either a lignite coal mining operation or in a power generating plant and only 5% of the respondents indicated there was lignite on their land to be mined, while 25% were uncertain whether they had mineable lignite or not. Apparently vicarious experiences have formed most attitudes toward relationships with energy industries.

Factor analysis of questions related to the restricted use of North Dakota resources and North Dakota's role in national conservation suggested that students may hold similar views about familiar processes such as electrical production, wheat growing, vacations and hunting, while relatively new activities such as development of local coal reserves and fuel rationing produce somewhat different response patterns.

When questioned about using electricity produced in North Dakota in other states, opinion was evenly distributed across a five-point continuum ranging from "agree" to "disagree." Student opinion about selling North Dakota wheat to other countries produced a bimodel distribution. The largest percentage (36) felt that wheat should only be sold to people living in the United States. A strong negative reaction was expressed to the statement that residents should restrict their vacation activities to North Dakota. Students were receptive to both travel outside the state and to recreational activities within the state by out-of-state residents. Generally, respondents expressed disagreement with the idea that North Dakota should be exempt from enrgy rationing measures because of the abundant energy resources in the state.

Eight items, each containing two opposing predictions or conclusions, dealt with the future of North Dakota relative to extensive coal production. Students chose the statement from each pair they felt to be most accurate and then indicated their degree of certainty about their choice. Seventy percent of the sample believed lignite coal development will produce new jobs, while only 29% believed relatively few new jobs will be created. Eighty-five percent of the students were either very certain or fairly certain about their responses to this item. A high degree of uncertainty (45%) exists about whether taxes would increase or decrease for residents in towns near coal mining. However, 35% felt taxes would decrease in such areas, while 64% felt taxes would increase. Eighty-seven percent of the 572 students in the representative sample believe that hunting and fishing will be affected adversely by coal mining, and 80% are either certain or fairly certain about their belief. Opinions about whether new people would be moving into the school district as a result of coal development was split. Fifty-five percent believed many new people will be moving in while forty-five percent feel that very few new people will arrive. Seventy-one percent of the respondents agreed that new people are good for the state. Only 29% believed an influx of new people would be bad for the state. A total of 87% were either certain or fairly certain about their feelings. The majority of students (59%) sensed that reclamation laws that presently exist in North Dakota are inadequate and should be strengthened. They expressed more uncertainty about their response to this question than to any of the others in this sequence. Opinions about whether North Dakota farmers will sell or lease their land to coal companies was split with 55% of the students predicting farmers would sell or lease quickly, while 44% favored the rather strong statement that farmers would never sell their land. Sixty-three percent of the sample believed North Dakota Indians would sell quickly, while 37% believed the Indians would never sell or lease. Seventy-two percent of the 25 students drawn from Standing Rock High School as the county sample from Sioux County selected the option stating that Indians would sell or lease.

A plot of student attitudes toward coal development showed that a distinct "gradient" exists across the 26 county region. The more negative attitudes (lowest scores) toward coal development were found in the southwestern part of the state, with the most positive occurring in the eastern and northwest portions of the study area. In counties where coal production is an on-going operation, such as Burke, Divide, Mercer, Oliver, and McHenry, mean scores tend to be above or near the regional mean of 6.2.

When asked whether an influx of new residents is good or bad for the region, North Dakota seniors overwhelmingly (71%) expressed the opinion that such a population increase would be good for the state. However, when county sample data was plotted, a regional pattern similar to that for attitudes toward coal development resulted in the area south and west of the Missouri River where fewer students believe more new residents are good for the state.

These data included samples from the communities that were investigated in detail by Lemmerman (1) who used a variety of community study techniques. Our data agrees with her results from interviews and questionnaires. Also, the attitudes of high school seniors were in close agreement with those of other segments of the adult community.

Although one might envision any number of design and financial problems associated with collecting this data from a region as large as most North Central states, we have not found these problems prohibitive. Instead, we have found that reliable information can be collected from a group of young adults such as high school seniors and we believe our design may be used with only slight modification with any one of several segments of the population.

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PUBLIC SECTOR IMPLICATIONS OF A COAL GASIFICATION PLANT IN WESTERN NORTH DAKOTA

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INTRODUCTION

Assessment of the economic and social effects of major industrial complexes is a topic of growing interest. Economic and social effects, which often are grouped together and termed "socioeconomic impacts," are of particular interest when large industrial plants are to be located in sparsely populated rural areas. An important component of socioeconomic impact is the effect of development on public sector costs and revenues. Rural communities often have sought to attract industry in the belief that it will produce an increase in public revenues. However, industrialization may be a fiscal detriment to local government if the revenues it produces are not as large as the additional public costs created by the industry and its resulting population increase (10). Garrison (5) reports that the establishment of new manufacturing plants in five towns had a negative fiscal impact (i.e., additional public costs exceeded additional public revenues) on most local government units. Crowley (1) finds that in-migrants to cities initially impose a net fiscal burden. Smith (14) reports that overbuilding of public facilities in response to a major dam construction project led to substantial increases in public costs and tax rates in an Oregon community.

Most previous studies have failed to consider either all of the added service costs, all of the added revenues, or both. A common practice has been to consider the added revenue produced by the plant and compare this to the added service costs attributed to plant workers (5, 10). This approach ignores tax revenues from worker's residences and other property. The secondary (indirect and induced) effects of industrial expansion also often have been ignored in previous studies, although there is evidence that these effects may be important in determining the overall net fiscal impact of a major new development.

In an analysis of fiscal impacts of industrialization on school districts, Hirsch (7) considered indirect and induced effects and concluded that unless state school aid transfer payments were considered, 13 of the 16 industry expansion cases studied would have a negative net fiscal impact on the school district. If increased school aid payments were included in school district revenue, then 10 of the 16 expanding industries would produce a positive fiscal impact. This study also indicates the importance of residential property as a source of local tax revenues. For all but one of the 16 industries examined, tax revenues from residential property increased more than did revenues from industrial and commercial property as a result of industrial expansion.

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The need for a model which local decision makers can employ to project the fiscal impact of a proposed new industry is apparent. A recent study by Kee (8) suggests that such a model must consider the nature of the labor force (income and number of dependents per worker), nature of the industry (especially the capital-labor ratio), residential patterns of the work force (location and type of housing), and the incremental costs of school and other services required.

The purpose of this paper is to report on the development of a model for ex ante evaluation of the effect of a new industry on public sector costs and revenues. Cost and revenue impacts are evaluated for both local and state levels of government during two time periods--the period of plant construction and the period of plant operation. The model considers the direct effects of the new industry and also the indirect and induced effects. Application of the model is demonstrated, using the example of a coal gasification plant (several of which are proposed for construction in western North Dakota).

THE MODEL

Adequate evaluation of a new industry's fiscal impact requires a model which reflects the interrelationships of business, household, and government sectors. Past analyses often have considered only the revenues received directly from the new development and the costs which can be assigned to it directly. The inadequacy of this approach is demonstrated by Hirsch (7). The model developed in this paper employs an input-output interdependence coefficient matrix to trace sector interrelationships. The interdependence coefficients matrix shows the total input requirements (direct, indirect, and induced) that must be obtained from the row sector per dollar of added output for final demand by the column sector. The column totals of this matrix are the total output requirements of all row sectors in the economy per dollar of output for final demand by the column sector.

A second major feature of the model is the consideration of cost and revenue timing. When large developments are built in rural areas, a frequent problem is that public costs both for construction of new physical facilities and for more intensive operation of existing facilities increase immediately. However, increased public revenues to finance these facilities typically do not become available until some time after they are needed. This may create serious short-term difficulties for impacted communities (6). Timing of costs and revenues is treated by separate analyses of the plant construction and plant operation periods.

The model has two major components--a set of regional input-output coefficients and a set of cost and revenue estimators. In concept, the model is similar to that of Hirsch (7). However, while the Hirsch model considers only one governmental unit (the local school district), both state and local levels of government are incorporated in this model.

The input-output model employed was derived from primary data collected by personal interview from firms and households in southwestern North Dakota. The model was developed by Sand (12) and the coefficients were subsequently tested for validity by Senechal (13). The model has 13 sectors and is closed with respect to households. Sector definitions are shown in Table 1. The input-output model is used to estimate the indirect and income induced changes in business volume, employment, and income. These estimates provide the basis for calculating public sector costs and tax payments.

TABLE 1. SECTOR DELINEATION OF NORTH DAKOTA INPUT-OUTPUT MODEL

Sector Number	Description of Economic Unit	SIC Code Number[a]
1	Agriculture; Livestock	Group 013
2	Agriculture; Crops	Groups 011, 012, 014, and 019
3	Mining	Division B
4	Construction	Division C
5	Transportation	Division E (Except Major Groups 48 and 49)
6	Comm. and Util.	Major Groups 48 and 49
7	Whls. and Agr. Proc.	Group 505
8	Retail	Major Groups 52, 53, 54, 55, 56, 57, 58, and 59
9	Fin., Ins., and R. E.	Division 6
10	Bus. and Pers. Services	Major Groups 70, 72, 73, 75, 76, 78, and 79
11	Prof. and Soc. Services	Major Groups 80, 81, 82, 84, 86, and 89
12	Households	All Households
13	Government	Division I

[a] Standard Industrial Classification Code defined in the Standard Industrial Classification Manual.

General Assumptions

1. Public sector revenues are computed using North Dakota's 1974 tax laws. All public revenues and costs are computed on the basis of 1972 prices.

2. Estimation of increased local gross business volume obtained through use of the interdependence coefficients of the input-output model assumes that the effects of the initial stimulus have had time to work themselves out.

3. Added household revenues resulting from direct plant payroll and from indirect and induced effects represent a net gain to the state as new employees will either be in-migrants or persons presently unemployed or not in the labor force.

The Detailed Model

For greater ease of exposition, the model is divided into two submodels--one which relates the new industry to changes in public revenue and the other which relates it to changes in public costs.

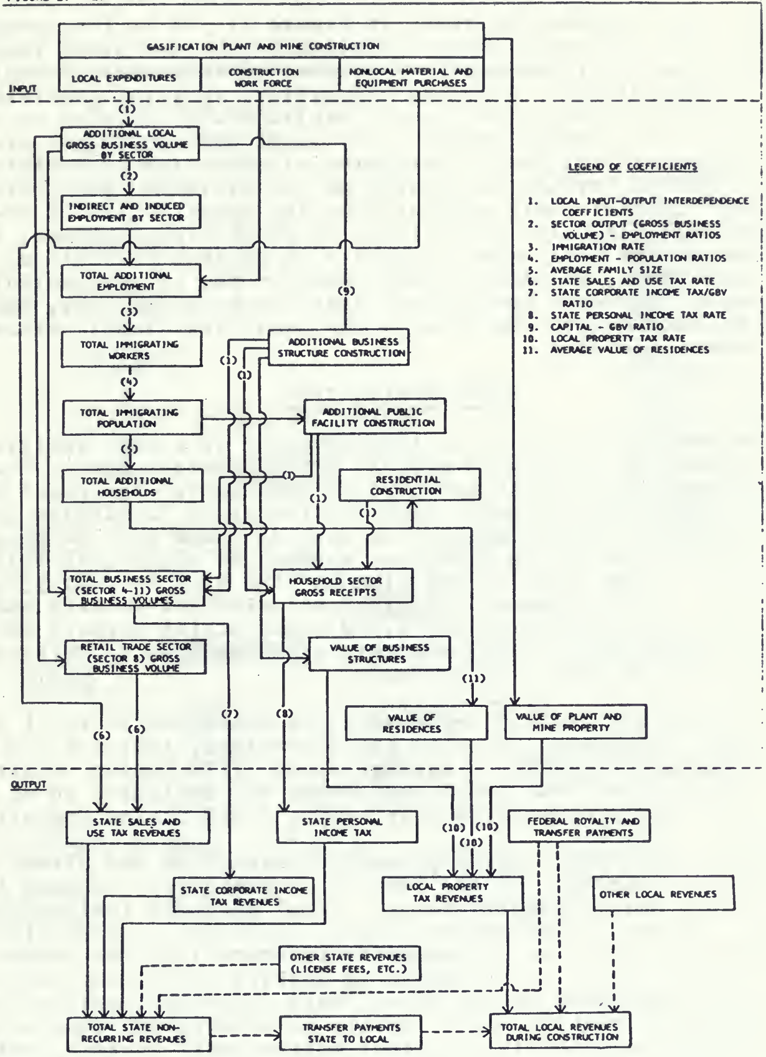
The revenue submodel (Figure 1) begins with the initial economic stimulus provided by the operation of the plant. This direct stimulus occurs through local expenditures of the plant for labor, materials, and various services and utilities. Local expenditures generate additional gross business volume in the local economy and the magnitude of the increase is estimated through use of input-output interdependence coefficients. These estimates of increased gross business volume of the various sectors are used in subsequent estimation of area employment, population, and tax base changes.

Additional employment (indirect and induced) is estimated for each economic sector except the household sector by dividing the increased gross business volume of the sector by the sector's ratio of gross business volume to employment. Estimates of the total additional employment (direct plus indirect and induced) resulting from the new plant's operation provide the basis for estimating the additional population of the area and the number of additional households. The number of additional households then provides the basis for estimates of increased residential property value.

Revenues are estimated for both state and local levels of government. Under North Dakota's 1974 tax laws, state revenues came primarily from sales and use tax, personal income tax, and corporate income tax (4). State sales and use tax revenues are estimated by applying the sales tax rate to the additional gross business volume of the retail trade sector. Personal income tax receipts are estimated by applying the ratio (total state personal income tax collections ÷ total state personal income) to the added personal income (direct, indirect, and induced) resulting from plant operation. The change in gross receipts of the household sector is assumed to be equivalent to increased personal income. State corporate income tax revenue is estimated by applying the ratio (corporate income tax collections ÷ gross business volume of all business sectors) to the total increased gross business volume of all nonfarm business sectors. Corporate income taxes collected directly from the new plant are estimated separately. Other state revenue sources include the vehicle fuel tax and various excise taxes and a portion of royalty payments made by mining firms to the federal government. However, the revenues from these sources have not been estimated.

The principal source of local government revenues in North Dakota is the ad valorem property tax which accounted for more than 95 percent of all locally collected taxes in 1972 (4). The estimate of added property tax revenue is developed by applying the property tax rate to the taxable value of the new plant and its ancillary facilities (in this case, pipelines and a coal mine) and also to the value of added business and residential structures. Other sources of financial support for local governments include (a) other local tax collections including estate tax, (b) transfer payments from state government, and (c) transfer payments from federal sources. Transfer payments constitute a significant source of support, but estimation of the effects of a new industry upon the magnitude of these

FIGURE 1. FLOW CHART OF REVENUE ESTIMATION FOR A COAL GASIFICATION PLANT, NORTH DAKOTA, 1974*


INPUT
GASIFICATION PLANT AND MINE CONSTRUCTION
LOCAL EXPENDITURES
CONSTRUCTION WORK FORCE
NONLOCAL MATERIAL AND EQUIPMENT PURCHASES
(1)
ADDITIONAL LOCAL GROSS BUSINESS VOLUME BY SECTOR
(2)
INDIRECT AND INDUCED EMPLOYMENT BY SECTOR
TOTAL ADDITIONAL EMPLOYMENT
(3)
TOTAL IMMIGRATING WORKERS
(4)
TOTAL IMMIGRATING POPULATION
(5)
TOTAL ADDITIONAL HOUSEHOLDS
(9)
ADDITIONAL BUSINESS STRUCTURE CONSTRUCTION
(1)
(1)
ADDITIONAL PUBLIC FACILITY CONSTRUCTION
(1)
(1)
RESIDENTIAL CONSTRUCTION
(1)
TOTAL BUSINESS SECTOR (SECTOR 4-11) GROSS BUSINESS VOLUMES
HOUSEHOLD SECTOR GROSS RECEIPTS
RETAIL TRADE SECTOR (SECTOR 8) GROSS BUSINESS VOLUME
VALUE OF BUSINESS STRUCTURES
(11)
VALUE OF RESIDENCES
VALUE OF PLANT AND MINE PROPERTY
(6)
(6)
(7)
(8)
LEGEND OF COEFFICIENTS
1. LOCAL INPUT-OUTPUT INTERDEPENDENCE COEFFICIENTS
2. SECTOR OUTPUT (GROSS BUSINESS VOLUME) - EMPLOYMENT RATIOS
3. IMMIGRATION RATE
4. EMPLOYMENT - POPULATION RATIOS
5. AVERAGE FAMILY SIZE
6. STATE SALES AND USE TAX RATE
7. STATE CORPORATE INCOME TAX/GBV RATIO
8. STATE PERSONAL INCOME TAX RATE
9. CAPITAL - GBV RATIO
10. LOCAL PROPERTY TAX RATE
11. AVERAGE VALUE OF RESIDENCES
OUTPUT
STATE SALES AND USE TAX REVENUES
STATE PERSONAL INCOME TAX
(10)
(10)
(10)
FEDERAL ROYALTY AND TRANSFER PAYMENTS
STATE CORPORATE INCOME TAX REVENUES
LOCAL PROPERTY TAX REVENUES
OTHER LOCAL REVENUES
OTHER STATE REVENUES (LICENSE FEES, ETC.)
TOTAL STATE NON-RECURRING REVENUES
TRANSFER PAYMENTS STATE TO LOCAL
TOTAL LOCAL REVENUES DURING CONSTRUCTION

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*ASSUMES 1974 TAXATION POLICIES ARE IN EFFECT (ALL REVENUES ARE IN 1972 PRICES).
DASHED LINES (---) REPRESENT REVENUE FLOWS NOT ESTIMATED BUT INCLUDED FOR CONCEPTUAL COMPLETENESS.

payments requires a complex set of assumptions. Consequently, while these payments are included in Figure 1 for conceptual completeness, their magnitude has not been estimated.

The cost submodel is shown in Figure 2. As in the revenue submodel, the initial stimulus provided by the new plant generates increases in gross business volume and increases in employment and population. Increased population, in turn, generates added demands on public services. Public costs increase at both state and local levels; however, the local cost increases are the area of greatest interest. Estimates of operation and maintenance costs of public services are based on the estimated population increase. Capital costs arising from the construction of new service facilities also are related to population increase, taking into account any excess capacity in present facilities. In many rural areas, existing excess capacity may be substantial in relation to increased needs; and, where this is the case, the effect on local costs and thus on the local net fiscal resources could be considerable.

MODEL APPLICATION

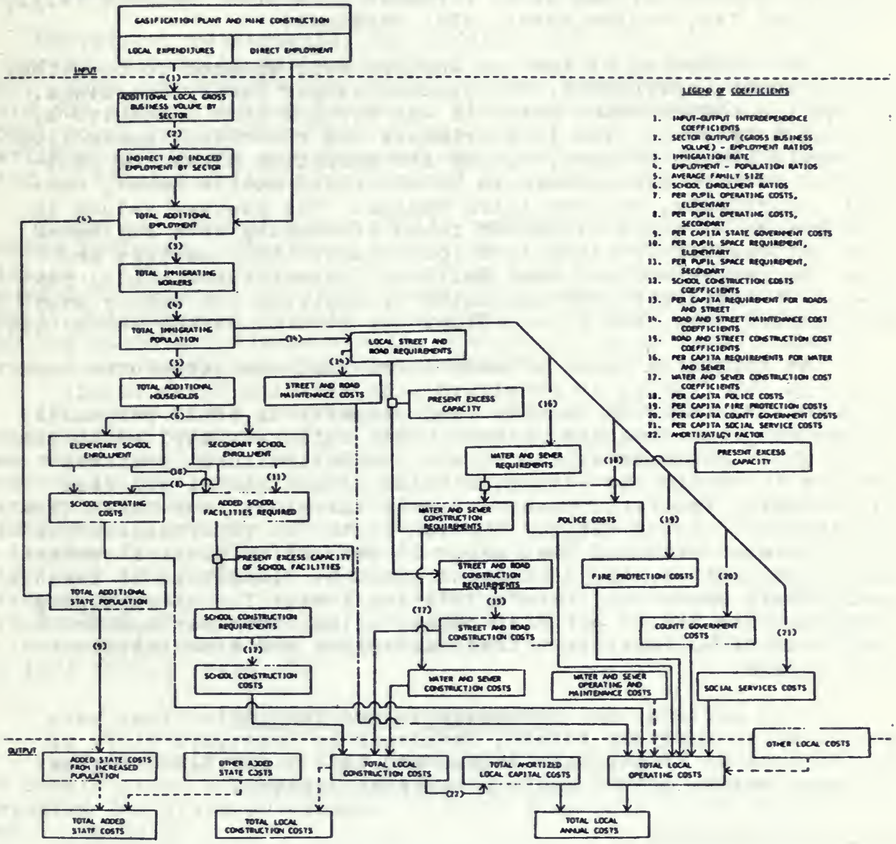
The model was applied to the situation of a coal gasification plant to be located in western North Dakota. Mercer County, North Dakota, was the assumed site of the plant. The plant will convert lignite to synthetic pipeline gas using 12 million tons of coal annually and producing 250 million cubic feet of synthetic gas per day. The plant was assumed to employ 625 full-time workers when in full operation and the mine to fuel it about 300. Construction of the plant was expected to take about three years with an average of 2,200 construction workers employed. Estimates of local expenditures developed by Dalsted (3) were used as input for the model.

Indirect and induced employment was estimated to total about 1,400 during the operation phase; whereas, indirect and induced jobs were expected to average about 3,214 during construction. Thus, total additional employment was estimated to be about 5,400 during construction and about 2,300 during operation.

During the construction phase, 50 percent of the direct employees and 25 percent of the indirect workers were assumed to migrate into Mercer County giving a total of 1,904 immigrating workers. During the operation phase, 50 percent of both direct and indirect workers were assumed to relocate into the county giving a total of 1,161 in-migrating workers during the operation phase. The remainder of the direct work force was expected to be comprised of workers hired locally or intercounty commuters, while the remainder of the indirect workers will include workers hired locally, commuters, and workers whose jobs will be located outside the county. A detailed discussion of the basis for these assumptions is provided by Leholm (9).

The ratio of population to employment was estimated to be 2.65 based on the historic trend in North Dakota's population-employment ratio. The average family size was assumed to be 3.25 persons (the average family size for North Dakota according to the 1970 United States Census of Population).

FIGURE 2. FLOW CHART OF COST ESTIMATION FOR A COAL GASIFICATION PLANT, NORTH DAKOTA, 1974


GASIFICATION PLANT AND MINE CONSTRUCTION
LOCAL EXPENDITURES
DIRECT EMPLOYMENT
INPUT
(1)
ADDITIONAL LOCAL GROSS BUSINESS VOLUME BY SECTOR
(2)
INDIRECT AND INDUCED EMPLOYMENT BY SECTOR
TOTAL ADDITIONAL EMPLOYMENT
(4)
(3)
TOTAL IMMIGRATING WORKERS
(4)
TOTAL IMMIGRATING POPULATION
(13)
LOCAL STREET AND ROAD REQUIREMENTS
(14)
STREET AND ROAD MAINTENANCE COSTS
PRESENT EXCESS CAPACITY
(5)
TOTAL ADDITIONAL HOUSEHOLDS
(6)
ELEMENTARY SCHOOL ENROLLMENT
SECONDARY SCHOOL ENROLLMENT
(10)
(8)
(11)
SCHOOL OPERATING COSTS
ADDED SCHOOL FACILITIES REQUIRED
PRESENT EXCESS CAPACITY OF SCHOOL FACILITIES
TOTAL ADDITIONAL STATE POPULATION
SCHOOL CONSTRUCTION REQUIREMENTS
(12)
SCHOOL CONSTRUCTION COSTS
(9)
(16)
WATER AND SEWER REQUIREMENTS
(18)
PRESENT EXCESS CAPACITY
WATER AND SEWER CONSTRUCTION REQUIREMENTS
POLICE COSTS
(19)
STREET AND ROAD CONSTRUCTION REQUIREMENTS
FIRE PROTECTION COSTS
(20)
(15)
(17)
STREET AND ROAD CONSTRUCTION COSTS
COUNTY GOVERNMENT COSTS
(21)
WATER AND SEWER CONSTRUCTION COSTS
WATER AND SEWER OPERATING AND MAINTENANCE COSTS
SOCIAL SERVICES COSTS
OTHER LOCAL COSTS
OUTPUT
ADDED STATE COSTS FROM INCREASED POPULATION
OTHER ADDED STATE COSTS
TOTAL LOCAL CONSTRUCTION COSTS
TOTAL AMORTIZED LOCAL CAPITAL COSTS
(22)
TOTAL LOCAL OPERATING COSTS
TOTAL ADDED STATE COSTS
TOTAL LOCAL CONSTRUCTION COSTS
TOTAL LOCAL ANNUAL COSTS
LEGEND OF COEFFICIENTS
1. INPUT-OUTPUT INTERDEPENDENCE COEFFICIENTS
2. SECTOR OUTPUT (GROSS BUSINESS VOLUME) - EMPLOYMENT RATIOS
3. IMMIGRATION RATE
4. EMPLOYMENT - POPULATION RATIOS
5. AVERAGE FAMILY SIZE
6. SCHOOL ENROLLMENT RATIOS
7. PER PUPIL OPERATING COSTS, ELEMENTARY
8. PER PUPIL OPERATING COSTS, SECONDARY
9. PER CAPITA STATE GOVERNMENT COSTS
10. PER PUPIL SPACE REQUIREMENT, ELEMENTARY
11. PER PUPIL SPACE REQUIREMENT, SECONDARY
12. SCHOOL CONSTRUCTION COSTS COEFFICIENTS
13. PER CAPITA REQUIREMENT FOR ROADS AND STREET
14. ROAD AND STREET MAINTENANCE COST COEFFICIENTS
15. ROAD AND STREET CONSTRUCTION COST COEFFICIENTS
16. PER CAPITA REQUIREMENTS FOR WATER AND SEWER
17. WATER AND SEWER CONSTRUCTION COST COEFFICIENTS
18. PER CAPITA POLICE COSTS
19. PER CAPITA FIRE PROTECTION COSTS
20. PER CAPITA COUNTY GOVERNMENT COSTS
21. PER CAPITA SOCIAL SERVICE COSTS
22. AMORTIZATION FACTOR

DASHED LINES (---) REPRESENT REVENUE FLOWS NOT ESTIMATED BUT INCLUDED FOR CONCEPTUAL COMPLETENESS.

Revenue Determination

Added public revenues resulting from construction and operation of the new plant were estimated for both local and state government. Local revenues from property taxes were estimated, but local revenues from other sources were not. State revenues from sales and use tax, personal income tax, and corporate income tax were estimated, but state revenues from other sources (e.g., motor fuel tax, excise taxes, etc) were not.

The residences of the new workers were assumed to be either mobile homes, apartments, or detached single family dwellings. During the construction phase it was assumed that one-third of the migrants would live in apartments and two-thirds would live in mobile homes; whereas, during the operation phase the residential pattern was assumed to be one-third mobile homes, one-third apartments, and one-third houses. The average values in 1972 prices of these different types of housing were estimated from information obtained from local mobile home dealers and from the Fargo-Moorhead Home Builders' Association. Local revenue from residences was estimated by applying the county average property tax rate (i.e., $1.65 per $100 of market value) (11).

The estimated value of additional business structures was based on the finding by Prestgard (18) that the North Dakota average investment on taxable real property is $0.22 per dollar of annual gross business volume. This ratio was applied to the total gross business volume of all non-agricultural business sectors to obtain the estimated value of additional business structures. The total plant and mine investment was taken from Dalsted (3). After discussion with State Tax Department officials, it was estimated that about 15 percent of plant investment and 10 percent of mine investment would be classified as taxable real estate under the state's 1974 tax laws. The average property tax rate ($1.65 per $100 market value) then was applied to the value of business structures and plant and mine taxable real estate.

State personal and corporate income tax collections were estimated by applying ratios, developed by Prestgard (11), of $1.15 per $100 of personal income and $0.113 per $100 of gross business volume of all nonfarm business sectors.

Cost Determination

The magnitude of increase in public service costs for local governments will depend primarily on the size of the population increase and the capacity of the existing infrastructure to absorb more people. The greater the number of new residents and the less developed the pre-existing set of public services in the area, the greater will be the expenditures required to provide public services. This analysis assumed no excess capacity in any of the public services in Mercer County. Accordingly, estimates of increases in public costs were based on the expected increase in population or the expected number of additional users of a particular service (e.g., public schools).

Operating and maintenance costs were estimated for schools, streets, police and fire protection, county government (excluding county roads), and social service costs. Capital costs were estimated for school facilities and streets. Operating and maintenance costs were based on historical costs for various services in North Dakota. Capital costs were based on engineering estimates of the cost of new facilities and were amortized over 20 years at 7 percent interest. A detailed discussion of all estimation procedures and data sources is provided by Prestgard (11).

Operation, maintenance, and capital costs for water and sewer systems and solid waste disposal typically are charged as user fees. Thus, changes in the costs of these services ordinarily would not affect the tax levies of the local governments. Additional costs for construction of expanded water treatment and distribution systems and expanded waste water systems were estimated by Prestgard (11), but are not included in this paper.

There are several other public services financed from local sources including libraries, parks, and other recreational facilities. (These costs are grouped as "other local costs" in Figure 2.) Because the requirements for these services vary greatly depending on various site-specific factors and because they represent a relatively minor portion of total local expenditures, these costs have not been estimated in this study.

Increased state government costs may be divided into those costs arising primarily from population growth and those arising from other sources. The latter category includes added costs incurred in monitoring plant and mine compliance with various state environmental protection laws and added costs of highway maintenance. However, these costs were expected to be offset by license fees collected from the plant and mine and by added motor fuel tax revenues. Hence, estimates of these cost increases were not presented. Costs for state general government functions were assumed to be constant per capita and the estimated increase in these costs was based on average per capita costs for the 1972 and 1973 fiscal years (2).

FINDINGS AND CONCLUSIONS

Tax revenue, public cost, and net fiscal impact estimates for construction and operation of a coal gasification plant are presented for state government in Table 2 and for local government in Table 3.

State Fiscal Impact

State revenues from personal income tax, corporate income tax, and sales and use tax were expected to total more than $24 million during the three-year construction period. State revenues were estimated to exceed state costs by more than $12 million during the construction period with sales and use tax on the materials and equipment for plant construction accounting for about 75 percent of the total. During the operation period annual state revenues were estimated to be $3.2 million (Table 2). The net fiscal impact for state government was positive in the operation phase also, amounting to $1.5 million annually for a total of $45 million during the 30-year period of plant operation. Thus, increased state government revenues were estimated to exceed increased costs by more than $57 million over the

TABLE 2. INCREASED REVENUES AND COSTS OF STATE GOVERNMENT RESULTING FROM CONSTRUCTION AND OPERATION OF ONE GASIFICATION PLANT, NORTH DAKOTA (1972 PRICES)

Item	Construction Phase (\$1,000)	Operating Phase (\$1,000)
"One-Time" Tax Revenues:[a]		
Total	24,309	---
Annual Average[b]	8,103	---
Annually Recurring Tax Revenues[c]	---	3,202
Annual State Government Costs	3,980	1,707
Net Fiscal Impact (revenues minus cash):		
Annual	4,123	1,495
Total[d]	12,369	44,850

[a] Includes personal income tax, corporate income tax, and sales and use tax receipts during construction phase and also income and sales tax from business structures and public facility construction for operating phase.

[b] Average for a three-year construction period.

[c] Includes sales and use tax, personal income tax, and corporate income tax.

[d] Assumes construction phase of three years and operation phase of 30 years.

lifetime of the plant. However, it should be noted that transfer payments were not included in the calculation of state fiscal impacts. In recent years, the state has made substantial payments to school districts. If the allocation policies used in recent years were continued, state transfers to local schools would be increased by about \$450,000 annually during the operation phase of the project. Even larger payments could be expected during the construction phase. Such transfer payments would reduce the net fiscal gain of state government and provide a corresponding increase in fiscal resources available to local government.

Local Fiscal Impacts

Local tax revenues were estimated to be much less than local costs during the period of plant construction. Local tax revenues were estimated to increase by \$449,000 in year 2, of which \$100,000 was tax revenues from new residences and business structures and \$349,000 was revenue from property tax on the plant and related facilities (Table 3). In year 3, local tax revenues from the plant, new business structures, and residences were estimated to be \$1,013,000 of which \$814,000 was tax on the plant. However, added revenues fell short of added local costs. Additional operating and maintenance costs for schools, fire and police protection, social services, streets, and general local government functions were estimated to amount to \$703,000 annually. At the same time, the local governmental units will be required to make substantial capital improvements. When repayment and debt service costs were added to the operating and maintenance costs, the net fiscal impact was negative and exceeded \$1 million at the end of the construction period.

TABLE 3. NET FISCAL IMPACT ON LOCAL GOVERNMENT OF CONSTRUCTION AND OPERATION OF A COAL GASIFICATION PLANT BY YEAR, MERCER COUNTY, NORTH DAKOTA (1972 PRICES)

Year	Revenue[a]	Current Operating Cost[b]	Capital Improvements		Fiscal Balance[e]	
			Original Cost[c]	Repayment and Debt Service[d]	Current	Cumulative
	($1,000)	($1,000)	($1,000)	($1,000)	($1,000)	($1,000)
Construction Phase[f]						
1	0	352	2,780	---	-352	-352
2	449	703	2,780	262	-516	-868
3	1,013	703	0	525	-215	-1,083
Operating Phase						
4	1,363	608	818	525	+230	-853
5	1,363	608	0	602	+153	-700
:						
10	1,363	608	0	602	+153	+65
:						
15	1,363	608	0	602	+153	+830
:						
20	1,363	608	0	602	+153	+1,595
:						
25	1,363	608	0	0	+755	+4,484
:						
30	1,363	608	0	0	+755	+8,259
:						
33	1,363	608	0	0	+755	+12,034

[a] Includes all local government (municipal, school district, and county) revenues from property tax collections.

[b] Includes operating and maintenance costs for schools, streets, fire and police protection, social services, and general government services.

[c] Major capital improvements are schools and streets. Capital improvement estimate for operation phase assumes that two-thirds of housing for operation phase workers is housing used in construction phase.

[d] Assumes that needed public facilities are constructed in first two years of construction period and first year of operation period. Repayment and debt service for a given facility begins the year after it is built with a 20-year repayment period and 7 percent interest.

[e] Fiscal balance is difference between current revenue and the sum of current operating cost and repayment and debt service payments.

[f] Construction phase revenue estimate is based on the assumption that one-half of taxable residences and business structures associated with the construction phase are built in year 1 (first taxed in year 2) and one-half in year 2 (first taxed in year 3) and also that 30 percent of taxable value of plant and mine is constructed in year 1 (first taxed in year 2) and 40 percent in year 2 (first taxed in year 3).

During the operation period, the local fiscal situation was much improved because the entire taxable value of plant and related facilities was added to the tax base. In addition residential property valuations increased substantially as one-third of the long-term workers were assumed to live in single family dwellings which would have an average taxable value almost eight times as great as that of a mobile home. The current net fiscal impact was estimated to be positive throughout the operating period and the cumulative net fiscal balance became positive in year 10. The overall net impact for the entire period of plant construction and operation was positive and equal to about $12 million.

SUMMARY

The net fiscal impact for state government was positive and quite substantial. The net impact for local government over the plant's assumed life of 30 years also was positive. However, the timing of revenues and costs is very important to local government as substantial negative impacts occur during plant construction. Transfer payments from state or federal government or a prepayment of taxes by the gasification company are possible means for easing these short-run burdens on local government.

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SOCIAL IMPACTS OF COAL GASIFICATION
OR
A PRACTICAL JOKE

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INTRODUCTION

According to dictionaries one of the synonyms of "practical" is "useful."

Many would say that any technology exists because it is practical in the sense of being "useful." I wish to argue that one developing technology, coal gasification, is practical in quite a different sense. The gas produced by this technology will be useful to those who burn it as a clean fuel, and the profits produced by the technology will be useful to the companies and their stockholders. But for the people who live in the impacted areas the practical aspect is that of practical joke.

A practical joke isn't very funny. The dictionary notes that the humor from such a joke stems from the "tricking of an individual placed somehow at a disadvantage." My argument is that coal gasification, especially in the previously undeveloped Western coal fields, will trick not only individuals, but whole communities. The thesis that the technology of coal gasification will lead to grave social problems is not an original one. In fact, much of this paper will draw directly upon draft environmental statements (d.e.s.) prepared by the Department of the Interior for two gasification complexes proposed for the Navajo Reservation. Testimony from those hearings will also be quoted.

Social questions shouldn't be viewed from just one side, and the question of the need for synthetic natural gas will be addressed first.

The Need for Coal Gasification

Although I believe it is basically incorrect to equate demand with need, let us begin by looking briefly at past demand and projected demand for natural gas. Table I is taken from the WESCO Draft Environmental Statement (9). The numbers are in the unit "trillion BTU's." A more useful figure for our purposes is the unit "cubic ft." Fortunately, natural gas has a heat value of approximately 1000 BTU/cubic ft. so that the table can be read equally well in billion cubic ft. In other words, item * is 22,734 trillion BTU, or 22.7 quadrillion BTU, or (at 1000 BTU/cu. ft.) 22.7 trillion cubic feet.

The first point to note about TABLE I is that is projects a much increased demand (from 22 to 39 trillion cubic ft.) between the years 1971 and 2000. Second, the domestic supply is

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TABLE I

Domestic Natural Gas Supplies and Supplementations
(Trillions of B.T.U.)

	1971	1975	1980	1985	2000
Domestic Supply	21,810	22,640	22,960	22,510	22,850
Synthetic Gas	---	---	700	2,000	5,500
Gas Imports	924	2,580	4,020	5,880	11,130
TOTAL	22,734*	25,220	27,680	30,390	39,980

projected to be just about constant during that period. (In other words, if our demand remained constant there would be no need for either synthetic gas or increased dependence on foreign gas.)

The third point, not shown by the table, is that we have a finite domestic supply of natural gas. At the 22 trillion cubic ft. per year usage, the United States will run out in the year 2010.

The broad, national picture has flaws. Some areas now using natural gas have fewer resources than others. Montana, which ships some of its own gas out of state, is dependent for 64 per cent of natural gas imports from Canada. In the Southwest, WESCO projects that "firm" consumers (e.g. households) would be denied gas by 1979 if only their own proven reserves are tapped (9).

This picture of local and national demand has led to intense research on new methods to gasify coal and to plans to utilize older technology for such gasification. Before going furtherwith the question of whether demand has anything to do with need, it will be useful to define, quantitatively, a basic gasification plant. TABLE II defines the physical requirements and productivity of a "standard" plant (Lurgi technology).

TABLE II

A Basic Gasification Plant:

Requires: 8-10 million tons coal per year

10,000 acre feet water per year

Costs at least $330,000,000

Requires 3,000 construction workers and 2 1/2 years to build

Produces 250 million cubic feet gas per day

For now the most important figure is the productivity: 250 million cubic ft. of gas per day. Let's assume for a moment that all our gas came from coal. How many plants would the nation have needed in 1971? How many plants would Montana have needed? Finally, how many would be needed nationally in 2000? TABLE III has the answers.

TABLE III

Number of Gasification Plants if All Gas Were Produced from Coal

Nation--1971	241 plants
Montana--1971	<one plant
Nation--2000	438 plants

It's a ridiculous table in a way. We obviously won't have 438 plants in the year 2000. President Ford's version of Project Independence calls only for 20 plants by 1985 and, from Table I, 60 plants are projected for the year 2000. Others suggest 90 plants by that year (5). But the table does show two things. First, Montana, which used only 212 million cubic ft./day of gas in 1971, could probably be served for most of this century by one standard plant. Second, someday the natural gas will run out, and TABLE III gives some notion of how many plants would be required if we chose to continue to heat our buildings with that fuel. (As an aside, the known strippable coal reserves in this nation would last for 40 years if they were used for nothing else but producing gas by current technology.)

But is need the same as demand? The economists have one way of looking at this question. Simply stated, demand decreases as price increases. This argument has been used to suggest that coal gasification will not be important in Montana (8). Unfortunately for the residents of Eastern Montana and the Navajo Reservation, local shortages or possibilities of subsidies to gasification companies may bring on the plants anyway.

I choose to go to the dictionary again, where one of the definitions of need is most revealing. Need: "A physiological or psychological requirement for the homeostasis of an organism." The idea of homeostasis (dynamic equilibrium) is of interest in and of itself--particularly if one recalls the projected 77 per cent increase of "needed" natural gas (TABLE I) by the year 2000. Such an increase clearly falls outside of the "homeostasis" ideal.

But the idea of "physiological requirement" is even more revealing. Humans have no "physiological requirement" for natural gas (in fact, it's toxic). Rather, the real requirement is for heat, and one technological way of securing that heat is by burning certain fuels. Later in the paper I will return, briefly, to heat and ways to secure it. For now it is important to remember that there are also "psychological requirements" for individuals and for communities, and we turn to social impacts of gasification plants.

SOCIAL IMPACTS

Although 90 per cent of the information in this section of the paper will come from the New Mexico experience, the analogy to Montana should be kept in mind constantly. The most obvious analogy is the possibility that the equivalent of seven coal gasification plants may be built on the Crow Reservation. The most frightening thing about coal gasification is the enormity of the enterprise. Sufficient water and coal exist in the state of Montana to supply the raw materials for a large number of gasification plants, and such plants would very likely be bunched closely together to ensure efficient use of pipelines.

The Setting in New Mexico

Two companies, El Paso Natural Gas and WESCO, are planning to build the equivalent of seven gasification plants (definition from TABLE II) in the Four Corners area of New Mexico. Figure 1 shows the location of the proposed plants in relation to the cities, towns, Navajo chapter houses, and other industrial facilities already on line. In the next few paragraphs I will discuss this setting from both geographical and sociological viewpoints.

The area is desert-like (5-7 inches rainfall/year), with all elevations over 5000 ft. The major river, the San Juan, flows northwest into Utah, merging with the Colorado in Lake Powell. Water for gasification will come from the San Juan, which has had a regulated flow since 1962 when the Navajo reservoir was built.

Three major developments, in addition to gasification, have already or may soon occur in the area shown in Figure 1. The Four Corners power plant is on the Navajo Reservation, and a second plant, the San Juan, located just north of the reservation, is producing power at about one-fifth of its eventual (1979) capacity. A third project, the Navajo Indian Irrigation Project has not yet begun although the reservoir was built ostensibly for that purpose.

Although there are several major landmarks (e.g. Shiprock and Hogback Mountain) the major geographical boundaries are those of the Navajo Reservation. The only "natural" part of these boundaries is the San Juan River which forms the northern edge of the Reservation from Farmington to a few miles east of Shiprock. This latter boundary is of sociological interest. The major city of the area (Farmington, population 30,000 estimated 1974) and two smaller towns, Fruitland and Kirkland, all lie on Highway 550 which runs just north of the Reservation. In fact, the entire stretch of road between the Navajo border just east of Shiprock and Farmington is being developed with homes, trailer courts, and various services. However, that stretch would still be classified as "agricultural," and, in fact, it's one of the few "river bottom" lands in that whole corner of New Mexico with soils which are good enough to support extensive gardening-farming.

Shiprock (population 10,000) is a Navajo town, which is booming in terms of housing developments but which is in the throes of a severe problem caused by the shutdown of a small

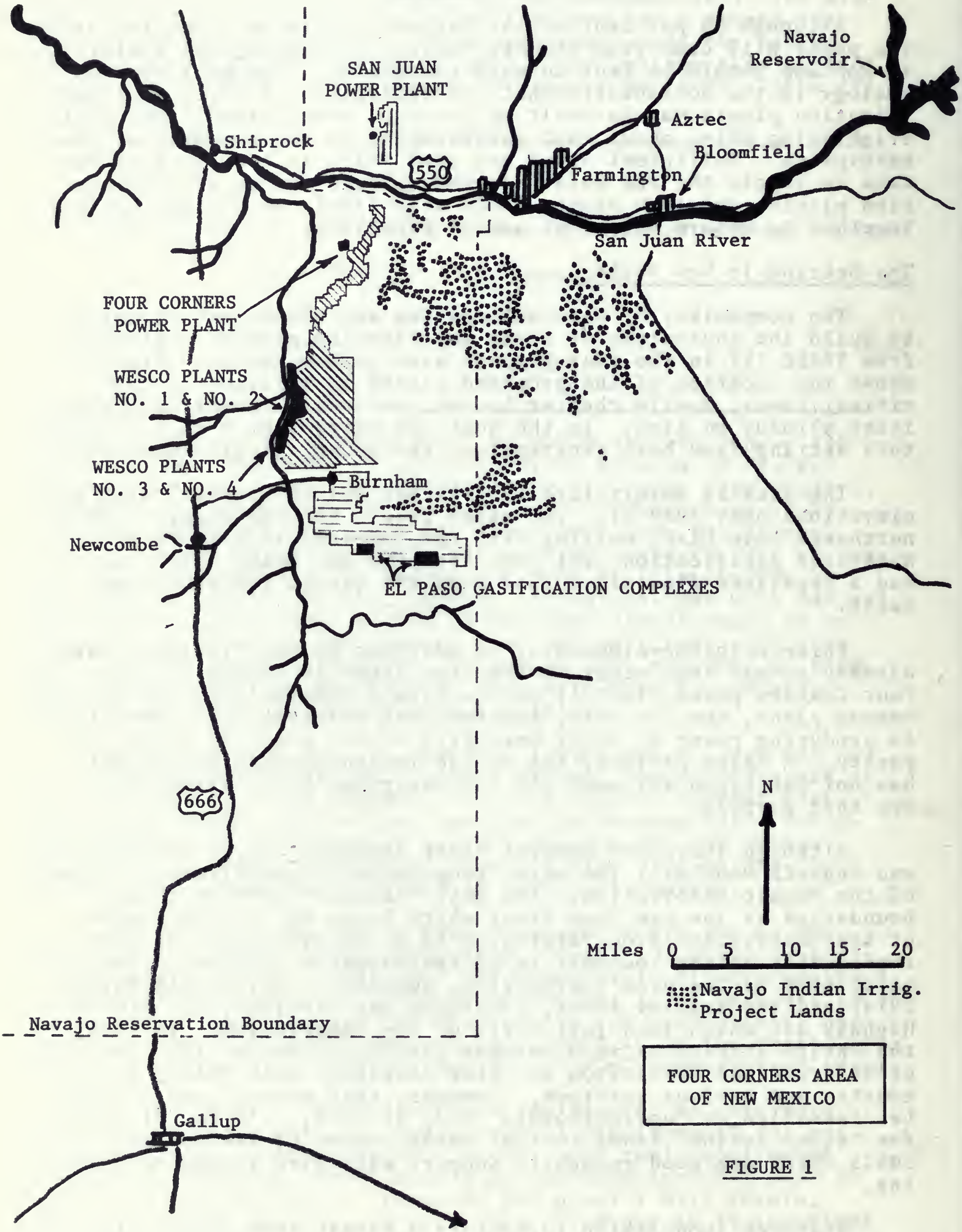
Navajo Reservoir
SAN JUAN POWER PLANT
Shiprock
Aztec
Bloomfield
550
Farmington
San Juan River
FOUR CORNERS POWER PLANT
WESCO PLANTS NO. 1 & NO. 2
WESCO PLANTS NO. 3 & NO. 4
Burnham
Newcombe
EL PASO GASIFICATION COMPLEXES
666
N
Miles 0 5 10 15 20
Navajo Indian Irrig. Project Lands
Navajo Reservation Boundary
FOUR CORNERS AREA OF NEW MEXICO
Gallup

FIGURE 1

Fairchild factory. Two "towns" to be mentioned later, Newcombe and Burnham, are really better classified as Navajo centers than as towns. Newcombe has a trading post and a small cluster of homes. Burnham has a few scattered buildings, with a church serving as a Navajo chapter center.

As can be seen from the map, Burnham lies within the El Paso mining area. In the El Paso d.e.s. it was emphasized that the 13-mile road from Highway 666 to Burnham was made of dirt and was often impassable. It is now paved and was the best road I encountered in New Mexico!

The major geographical-sociological point which the map and previous discussion does not cover is that the Navajo Reservation is very large. Most of the reservation is in Arizona rather than in New Mexico. The Burnham chapter is one of the most traditional and, until the new road was built, one of the most isolated of the Navajo Nation.

The population of all of San Juan County (1970) is 52,517. In considering impacts the d.e.s. chose to include the northern part of McKinley County also (total population 66,000). The Navajos expressed some concern with that population base, noting thatgasification plants would have a heavy impact on the total Navajo population of around 150,000 (7). (The latter figure was in doubt according to the environmental statements which estimate Navajo population between 95,000 and 121,000.) All such figures are somewhat misleading if one remembers that the actual population to be dispossessed on the gasification-mining sites consists of 91 families.

Cultural Impact on the Navajo

This is not the place for a discourse on Navajo culture. It is sufficient to say that a traditional culture does exist and that that culture is held to, not only by older Navajos who have lived on the land all of their lives, but also by a group of younger educated Navajos who live by their traditions even though they have a clear (and economically improved) choice not to do so.

The way of approaching the culture shock which would come with industrialization of the traditional Burnham area varied as to the "type" of traditional Navajo who spoke at the hearings. The older Navajos spoke of history, of land, of their sheep; the phrase heard most often was, "...from generation to generation." Testimony from younger persons included, "if you build that thing, there's going to be strong physical resistance," but usually was directed against the alleged inadequacies of the draft environmental statement itself. For example, a graduate student in economics noted that the Navajos had no way to decide on possible economic advantages of gasification plants since no economic analysis has ever been presented to the tribe. An articulate Navajo social scientist chided the Department of the Interior for spending so much time on meterology and plant life while nearly ignoring social questions. He echoed others as to the social decline anticipated in crime rate, traffic fatalities, child abuse, and divorce. In general, his criticism was that the d.e.s. was biased toward "modern" life styles (7).

Preconstruction Decisions--Intratribal, Interracial, and Intercommunity Conflicts

The WESCO and El Paso environmental statements note that the Burnham chapter of the Navajo Nation has voted several times about gasification plants coming into their area and that they have always rejected it. In some of the votes, the decision was unanimous. The Department of the Interior notes that the Tribal Council favors this industrial development. There is obviously, an intratribal conflict over this issue. The devisiveness of the issue was spoken to several times during the hearings on the El Paso application (7). Although I heard no Navajo speak for the development, several spoke with anguish over the split which the issue had engendered in their nation. What will hapen in the future because of this current problem is conjectural, but it seems likely that the "I told you so" rejoinder will be used no matter what out outcome.

A second preconstruction problem is that of interracial conflict. To many of the older Navajos who testified, gasification is just one of the white man's tricks. A young Navajo woman put the case more strongly: "Why are you so interested in killing us?" Her testimony was not only indicative of interracial conflicts, but she suggested the ultimate in intratribal conflicts--the impeachment of the current chairman of the Tribal Council.

The development of the coalfields of Eastern Montana has, of course, already brought out not only these, but intracommunity conflicts as well. The feelings of many ranchers and white communities about development have been well documented (3).

Construction Period--Opportunity Structure Conflicts

"In a social system the opportunity structure consists of the accepted ways to achieve goals emphasized or valued by the dominant culture" (9). For our purpose "opportunity structure" will be discussed in terms of who will get the jobs. Both El Paso and WESCO have gone to great lengths to assure the Navajo that a large percentage of construction workers will come from the local Navajo population. The WESCO d.e.s. suggests that Anglo residents with high access into the opportunity structure would suffer if the development doesn't occur and that traditional Navajos will suffer if it does. There is the third local group to consider--the Navajos who are actively striving toward Anglo goals ("values for success, upward mobility, status and economic development may be assumed to be among dominant (Anglo) values" (9). If they are unable to benefit economically through new job opportunities--if they are again denied access--then major social conflicts could result.

The environmental statements both admit that it is unlikely that the companies can find enough qualified workers to do the construction jobs. One estimate suggests 1500 of some 7000 construction jobs will be filled locally. Navajos at the hearings spoke to this problem several times. Recent developments in the closure of the Fairchild plant and a long history of what they consider to be job discrimination have given them little confidence in promises.

Population--The Magnitude of the Problem

In TABLE I it was shown that a gasification plant required 3000 construction workers. To that might be added the 600 permanent workers in the plant and the 400 workers necessary to mine the coal. These are the simple, easily obtainable numbers. It is more difficult to define realistic multipliers--to accurately predict future populations. Nonetheless, an attempt to predict the population of the impact area in New Mexico has been made. TABLE IV shows the results of that prediction. (The original table contains yearly predictions for three different sets of projections, but TABLE IV is representative of the longer computation (2).

The population figures include two other developments which are occurring (or are scheduled to occur) at the same time, the Navajo Indian Irrigation Project and the San Juan Power Plant. Because of this, the figures cannot be extrapolated directly to the Montana situation. Montana calculations will be presented later in this paper. Even casual inspection of TABLE IV reveals two major points. First, population in the Four Corners area of New Mexico is expected to increase rapidly in the next 12 years. Second, that population increase will come in a boom-bust sequence, with a drastic decrease occurring in a four-year period.

TABLE IV

Population Projections for San Juan and Northern McKinley Counties

Projection I	1974	1975	1976	1977	1981	1984	1986
Employment	1,700	7,300	13,300	22,475	24,375	14,675	13,250
Total Pop.	70,860	85,300	100,780	124,450	129,360	104,330	100,650
Projection III							
Employment	1,700	7,300	13,300	22,475	24,375	14,675	13,250
Resident	1,500	1,500	1,500	1,500	1,500	1,500	1,500
In-Migrant	200	5,800	11,800	20,975	22,875	13,175	11,750
Total Pop.	66,990	81,430	96,910	113,120	115,020	104,460	96,780

(The only difference between Projection I and III is that Projection III assumes that 1,500 workers will come from the area.)

Several other points must be emphasized about these population changes:

(1) Well planned (i.e. not simultaneous) building of plants allows for the construction phase to bring fewer transient workers into the area.

(2) The extensive work period (planned from 1975-1983) means that many of the "transients" will become accustomed to the area and will wish to stay.

(3) Closer (monthly and yearly) inspection of employment needs show many periods of sudden decreased in job opportunities in the eight-year construction phase. That is, unemployment is scheduled to be high throughout that period.

(4) The rapid growth will allow development of an infrastructure which will have excess capacity once the construction boom is over.

Added to these numerical problems are concerns about the type of growth to be allowed and the usual pleas for "planning." Farmington already has a 19 per cent proportion of mobile homes, and it is anticipated that that type of growth could predominate in the next few years--particularly along Highway 550. To quote the d.e.s., "While careful planning and coordination of housing development plans may help mitigate some of the negative effects associated with providing the large number of housing units necessitated by the projects low quality housing cannot be avoided." (2)

In addition to housing, other requirements which must be met include police, fire protection, schools, hospitals, roads, etc. Although these are assessed quantitatively in the d.e.s., their locations are of equal interest. Two possibilities--a new town to house 40,000 people, and an increase in the population of Farmington by 41,000--are suggested. The Department of the Interior clearly prefers the "new town" possibility. Such a town would be on the Navajo Reservation, on a site not yet chosen. However, it has been suggested that a good site would be due east of Burnham, where the town might serve both the gasification plants and part of the irrigation project. Of course, it is also assumed that the Navajo town would bear the brunt of the rapid population decline. Thus, it will have a population of 40,000 at the height of the boom, but will have only 20,000 thereafter.

Whichever alternative is chosen--and disregarding (if that is possible) thoughts of the anguish and unhappiness which will occur when 20,000 people must either leave town or go on permanent welfare--there is another kind of social problem brought on by the large population influx. It is a "decrease in the effectiveness of existing norms." (9) Norms are simply shared feelings of appropriate and inappropriate behavior. The construction workers from Denver and Phoenix have one set of norms, the Anglos of Farmington and the Navajos have others. A sudden mixing is predicted to lead to a state of normlessness in which no consensus of norms exists. According to the Department of the Interior, "Such a condition is experienced by participants variously as feelings of alienation, powerlessness, meaninglessness, estrangement, being controlled by powerful outside forces, and isolation." (9)

Health Effects

There is yet one social impact which has not been touched.

That is the health of the impacted community. At the hearings for the El Paso application several Navajos spoke of mental health problems, and one way to look at all that I've said so far on social impact is that incredible psychological pressure is to be put upon whole communities. But there is also a physiological health problem inherent in coal gasification which must be mentioned, even if briefly.

Chemically, coal gasification involves the hydrogenation of coal. The process to be used in New Mexico employs water (steam) at high pressures and temperatures to produce the hydrogen. A major set of byproducts from any such technology includes tar (88,000 lbs per hour) and tar oils (48,000 lbs per hour) (2). A chemically similar process, liquefaction, simply changes the conditions of the coal-hydrogen reaction in order to produce liquid, rather than gaseous hydrocarbons. The only health study of such a chemical process was carried out between 1952 and 1958 at Union Carbide's large pilot plant for coal hydrogenation (liquefaction and gasification) (6). That study showed that chemical carcinogenus (cancer-causing compounds) were formed in the hydrogenation process. Such a finding is in no way surprising from a chemist's viewpoint. What was surprising was the fact that, despite elaborate precautions, workers in the plant suffered skin cancers at a rate between 16 and 37 times that expected of a normal population (6).

Such findings do not indicate that coal gasification as planned for New Mexico or thought about for Montana will lead to similar problems. However, it was disturbing to find that no mention of such a potential problem was made in approximately 2000 pages of environmental statements. The fact is that total world production of gas from the process does not equal that of one plant of the size of the seven to be placed in New Mexico. From reading about the Union Carbide plant, it is obvious that it was an extremely dirty technology and that the Lurgi process must be cleaner. Nonetheless, some evidence that cancer is not prevalent among workers is Scotland, Korea, and South Africa (places with small-scale Lurgi technology) is needed for reassurance.

Application to Montana

There are 15 corporations (or partnerships of corporations) which anticipate coal-water packages large enough to develop coal gasifications complexes in Montana. Although we are not privy to the plans of these companies, it is reasonable to note (1) that many of the coal-water packages are large enough to support seven standard plants for 25 years, (2) that there has been some suggestion that the equivalent number of plants might be built on the Crow Reservation, (3) that pipeline economics seem to demand some clustering of plants. Therefore it is helpful to use the New Mexico analog directly to calculate population changes which might occur for a seven-plant development in Eastern Montana. Such projections have been calculated and appear in TABLE V. The data are for the years 1975-1984. Obviously any ten-year period could be used. The following assumptions from the Department of the Interior have been used (2,9):

(1) Construction jobs have a multiplier effect of 1.8.

(2) Manufacturing jobs have a multiplier effect of 1.26.

(3) Mining jobs have a multiplier effect of 2.20.

(4) Men will fill 67 percent of the new jobs created.

(5) Men have a 72 per cent labor force participation rate.

(6) Women have a 36 per cent labor force participation rate.

(7) Each adult worker in the area respresents a corresponding 1.74 children.

(8) The effect of Items 4-7 is to establish a multiplier of 2.58 for calculation of total population from new employment.

The boom-bust statistics for Montana are more striking than those for the Navajo Reservation (TABLE IV). There are several reasons for this. First, the Navajo situation was mitigated to some extent because of fortuitous phasing of construction work on the San Juan Power Plant and permanent jobs resulting from the irrigation project. Second, the projections contained errors, and a strange (unmentioned) change occurred in the multiplier for mining activities in the years between 1978 and 1982. Third (and most important from the purely numerical standpoint), TABLE IV shows two projections, one assuming that 1500 workers would come from the local work force. That assumption is reasonable for New Mexico, and results in less of an impact. It would be unreasonable to assume that any county in Eastern Montana (maximum population 13,000 vs. over 50,000 in New Mexico) would supply 1,500 workers from its present population.

It is easy to argue with the exactness of the figures in TABLE V. Multipliers for each of the types of jobs could be different in the future. Likewise, the general multiplier (jobs x 2.58 = population) used in New Mexico may not hold in the future in Montana where past experience suggests a higher ratio of 2.80 (1). But there can be no argument that such a development would cause rapid population growth (around 50,000 increase) followed by a large loss of population (around 20,000).

CONCLUDING REMARKS

When knowledge that a boom-bust development may occur, the usual suggestion is that "planning" must start. The "planning" always includes estimates of how many schools, hospitals, roads, homes, and other facilities or services must come on line. At the same time plans for legislation to route coal taxes to impacted communities and to provide for front end taxation of the incoming industry are made. Some have said, "The effects of industrialization must be accepted, however, planning and controls must be instituted to minimize adverse effects." (5) That's nonsense. The following three points show why "must be accepted" is basically false.

TABLE V

Population Projections for a Montana Town Impacted by Seven Gasification Plants

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
Construction	5,400	11,000	16,000	10,800	12,700	10,000	9,200	6,200	4,050	0
Operation	0	0	1,790	1,820	3,630	4,350	4,850	5,600	5,600	5,600
Mining	0	0	1,625	1,650	3,360	4,760	4,730	5,620	5,620	5,620
TOTAL EMPLOYMENT	5,400	11,000	19,415	14,270	19,690	19,020	18,780	17,420	15,270	11,220
TOTAL NEW POPULATION	13,900	28,400	50,000	36,800	50,700	49,000	48,500	45,000	39,400	28,900

First, the social costs to communities thus impacted far exceeds any partial mitigation which comes from such planning. Specifically, loss of cultural diversity (not only Native American but also ranching), increasing intracommunity conflicts, felt exclusion from the opportunity structure, and increased normlessness will occur with or without planning.

Point two is that coal gasification is not needed. The physiological requirement is for heat, not gas, and there is little doubt that current gas supplies plus supplementary use of solar heating for residences (the major user of natural gas at present) could meet reasonable demand for the next 25 years.

My final point brings me back to the Introduction of the paper. Coal gasification is a practical joke. In technology, function always takes precedence over form, and the technological optimist already has the 21st Century form of heat thought out thoroughly. It will be hydrogen, not natural gas or gasoline, which will serve as our mobile fuel. Coal gasification is destined to be an extremely short-lived technology. And the social costs of that basic fact are enormous. The Navajos already know that their "new" town of 40,000 (to be 20,000 in one year when construction ends) must decline even more precipitously when the coal runs out in 25 years, but they hope that a new agricultural industry, based on irrigation, will eventually allow for homeostasis. For Eastern Montana the prospect is more bleak. Its industrialization, particularly via coal gasification, will lead inevitably to only one semi-permanent industry. The punch line of the practical joke is a series of 21st Century ghost towns--nice for the tourist but hardly funny to the former residents.

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HOW DO YOU DESIGN A CITY THAT WILL SELF DESTRUCT IN 30 YEARS?

Ted Wirth*

Mike Potter, my associate, was scheduled to speak at this Symposium, but at the last minute a rather urgent project deadline made it impossible for him to be here. I will apologize for having to read much of my presentation, but I did not know until last evening at 5 P.M. that I was to stand in for Mike--- I offered to stand in for him -- with the clear understanding that the viability and successes that I will cover in my remarks regarding Colstrip are largely due to his professional capabilities as well as the philosophy of our profession of Landscape Architecture!

I note I am the only non-academic type on the program today. I am not sure what that signifies, but I am glad I was invited because I feel strongly about the need for not only high quality but quantified planning -- and that the efforts towards developing the regions resources are put in proper perspective.

The title of these brief remarks is, "How do you design a city that will self destruct in 30 years?"

The answer to that question, ladies and gentlemen, is quite simple. You do not -- at least you do not if you are a professional like ourselves. And I want to clearly and concisely emphasize this morning that in our firm's designing work in Colstrip, we have not.

Before getting into specifics about Colstrip I would like to set the stage by briefly talking about the philosophy of community planning that we followed in our work in creating an expanded and new town for Colstrip, Montana.

The fact that Man also is a real part of the total environment and his need must be taken into consideration and that somewhere between the overzealous guardianship of the mountain-born stream's pristine clarity and the old "environment be damned" approach to strip mining lies the underlying philosophy behind the approach to planning of man's use of land by the Landscape architectural profession.

The problems faced today in planning communities throughout the Mountain West are not new. To illustrate my point, let me quote what someone once said.

> "Companies have made lucrative business of buying attractive sites of comparatively wild land and arranging them as suburban additions, finding ready sales for lots at prices which pay a fair profit on the cost of improvement. Everywhere the demand has proved how readily the popular heart responds to the opportunity

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*Ted Wirth a Landscape Architect and President of Wirth Associates with offices in Billings/Denver/Phoenix--Environment/Socio-Economic/Land Use planning.

> and the revolution which has been effected in the condition of the country, affords sufficient evidence of the innate love of nature, and the longing to secure the enjoyment of her attractions."
>
> "The vast regions yet lying undisturbed between the Mississippi and the Pacific comprise such resources of wealth and variety of subline and picturesque features of natural scenery as can be seen in no other portion of the earth, that is accessible to civilization. This is the raw material which is placed in our hands to be moulded into shape for the habitations of a nation and as such as we create, it must essentially remain for all future time."

These words were written by Mr. H. W. S. Cleveland in his book, "Landscape Architecture as Applied to the Wants of the West" in 1873 (102 years ago).

Mr. Cleveland was well ahead of his time as were many of the Landscape Architect's who urged Communities to plan for the needs of unborn generations. They were the practical radicals of their day, determined to humanize the nineteenth century American city. The early Landscape Architect's professional sensitivity to topography and natural site advantages resulted in a more fundamental revolt against formalism with important implications for residential and community design.

One does not have to adopt the extreme pessimism of Friedrich George Juenger (The Failure of Technology) which views with some apprehension the effect of the machine upon the man, and even the effect of the machine upon natural resources from which man's life must derive. Juenger sees it as a sort of devil's dance in which the technologist has become a hapless victim of his own successes, and the machine has become "a hungry and pitiless consumer" instead of a producing agent. He sees the result as the abolition of the equilibrium between man's work and his leisure, and between man and nature.

The Landscape Architect feels the man who experiences daily association with a consciously ordered environment must inevitably become more sensitive to order, and must exert his awareness upon the community in which he lives. In other words our profession, we feel, has a common goal to determine, to create, and to keep current the optimum relationship between man and his environment. These, then, were our underlying philosophy and guidelines in developing plans for the expansion of Colstrip.

One of the key tools we used to accomplish this was to structure the plan for the town around an integrated system of parks and open space. The physical plan should be the result of a planning process, but that is only a part of the story. In the case of Colstrip, the story began many years ago when the Northern Pacific Railroad built a "Company town" to house its employees while mining coal to run the railroad. Typical of early Communities throughtout the west, is was layed out in a grid system of city blocks around a central square or park. There was no intigrated or planned open space. There were no recreation facilities or any of the important community amenities that allowed the citizens to relate to the community as their home town. They could not even buy their homes, but rented them. As a result, when the coal fired steam engines were replaced by the Diesel engines, Colstrip became a community that simply existed, but did not live, being occupied by only those who were employed by the railroad for continued limited mining operation or for teaching at the school which served the region.

The Western Energy Company took over the town and mining properties when Montana Power Company bought the area from the Northern Pacific Railroad. Western Energy clearly recognized that this archaic "company town" syndrome of old had no place in today's socio-cultural society. It recognized the need to address itself to the needs of the people who were employeed by the Company, and to develop a community identity having "esprit de corps."

It was, for the mountain west, a refreshing and new attitude, even when considering planning approaches being instigated in existing communities around Montana and Wyoming. The company sought expert help by hiring a well known planning firm from Denver to assess the socio-cultural and economic aspects of developing an expanded and new community to serve these goals. This general plan then became the starting point and foundation upon which we as consultants in joint venture began to develop a program and plan for the physical development of Colstrip as Montana's only new Community.

It should, I think, we made a matter of public record that Western Energy Company has not placed any constraints or limitations on our efforts to develop a plan that will meet the needs as identified in the goals. Quite the contrary---the company has been willing to invest in more planning studies and community amenities than were envisioned in the original planning document.

The planningprocess identified community needs from the base study and inventoried the physical and environmental opportunities as well as constraints. Such things as flood plains/ecosystems/soils/access/aesthetics/topography and other aspects were carefully analysed, and evolved into a physical plan to reduce impact and facilitate community life style. The result was a plan which contains 25% of the land dedicated to parks. In addition to this open space for parks 70% of the land used for housing is landscaped open space. These figures do not include the large school grounds. The open space/park complex combined with pedestrian underpasses allows for every resident to walk or ride a bike to the new parks, school and commercial center without crossing a road.

The Company, in addition to providing simply physical facilities, has instigated a broad range of community recreational and activity programs for both the young people and the adults. The Company's intention is to encourage and provide the means for the people to purchase the homes and develop their own community destiny and lifestyle, and to totally abolish the Company town syndrom.

While many people who do not live there have criticized Colstrip, those who do live there are more than enthusiastic.

In fact, the Company is experiencing a pressure from people working in areas outside Colstrip to live in Colstrip rather than in other existing communities. Some of those living in Colstrip are now talking of retiring in Colstrip.

We believe that Colstrip is evolving into a properly designed and constructed community. We do not feel that new communities need to "self destruct" or become ghost towns when alternative forms of energy reduce the demand for coal.

Because of its geographical location, community structure, and physical design, Colstrip could easily not only take its place among good rural communities, but also could serve as an example to other rural communities of the region on how to continue as an attractive and viable place to live and work, for just as there will be developed alternate sources of energy, so such communities can and will develop alternate sources of employment and industry to remain healthy and not self destruct when the original coal resource is exhausted.

A recent National Geographic Book quantifies the reversal of the movement of people to major urban areas. The book points out the desire of more and more people to seek today community living in a rural environment. Colstrip, as envisioned in the plans, is the kind of community these people are seeking and, we feel, will be seeking in the years ahead.

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STATUS REPORT ON LOCAL IMPACT MODELING
CASE STUDY: SAN JUAN COUNTY, NEW MEXICO

Michael D. McKay and Lawrence A. Bruckner*

INTRODUCTION

Within the frame work of a regional energy study, the objective we are attempting to reach is the development of models that can be used to study local impacts of energy development. This presentation describes our initial efforts towards the development of a Linear Programming model of a situation now confronting the Navajo Indians in Northwest New Mexico. The problem centers around the Navajo's option to allow construction of coal gasification plants, electric power generating stations and coal mines, and the potential interplay with the Navajo Indian Irrigation Project and Navajo employment. Our model is being designed to treat this situation. Although its state of development is still very crude, we hope that this progess report will serve to inform others of our work, and generate a productive dialogue on the general question of local impact.

DESCRIPTION OF PROBLEM

Primary Components

The primary components considered are (1) industry, (2) labor (Navajo/non-Navajo, and skilled/unskilled) and (3) natural resources (water and coal). Industries are divided into (1) primary industries (coal gasification, electric power generation, coal mining and agriculture) and (2) secondary industries (supporting business and municipal service). Supporting business encompasses all coal economic activity not covered by primary industries or municipal services. For example, retail trade and services would be called supporting. Municipal service refers to services and utilities generally provided by cities and counties. As the need arises, the secondary industries can be further subdivided.

For the purpose of this model we define industry by the following attributes:

(a) Length of time for construction, required construction labor force, salaries paid, etc.

(b) Required labor for operation, salaries paid, need for other industries and natural resources, unit output, etc.

At the present time we assume a constant economic incentive to construct and operate the various industries.

Limits to the number of units to be constructed and a

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minimum number of years of operation may be imposed. It seems obvious to us, for example, that no company would construct a coal gasification plant when the number of years it could operate due to coal availability would be less than some minimum. Since this initial model is concerned with the Navajo employment, we have divided the labor pool into three segments: Navajo, permanent non-Navajo and migrant non-Navajo. The definition of these three segments within the model is a difficult one which we have not completely answered. We are currently using the following attributes to distinguish among the segments: (a) average family size in community, (b) average lifetime in the community, (c) need for supporting business and municipal service. Since it is expected that many of the Navajo would maintain their residence on the reservation and commute to their employment, living in dormitory type housing during the week, their average family size and needs in the community will probably differ significantly from that of the other two segments. In passing, the model seems very sensitive to the value of the mean lifetimes in the community, currently five years for permanent and two years for migrant workers.

Interrelationships

Two classes of interdependencies exist among industries and between industries and the labor force. These are treated under the headings of Required Operation and Finance.

Under the Required Operation aspect of the model, we treat the "need" of one industry for the "output" of another industry and the need of the labor force for certain amounts of supporting business and municipal service. Additionally, requirements for labor and natural resources are included.

The Finance aspect covers construction and operation costs, intra-industry cash flow, labor-industry cash flow, and some exogenous cash flows.

Planning Horizon

Our model attempts to coordinate the construction and operation phases among the industries in one year steps over an extended period of time called Planning Horizon. The choice of the length of the Planning Horizon is critical, particularly with regards to the economic incentive to construct the physical plants.

LINEAR PROGRAMMING (LP) MODEL

What is L.P?

In general, Linear Programming (LP) can be thought of as a technique of finding a solution to a set of equations which minimizes a "cost" function, or more generally, optimizes a function called the objective function. An example is the "Diet Problem." Suppose we have two foods, each containing certain amounts of three vitamins, and each costing a certain amount per serving. If the daily requirements for the vitamins are set, the Linear Programming problem is to find a mixture of servings of the two foods which meets the vitamin requirements and, at the same time, costs the least. The LP approach to local impact modeling treats the relationships among industries and labor as it does the vitamin requirements above, so as to find an optimal solution which satisfies the relationships among labor and industries. Specifically, it finds a pattern of development for the industries which optimizes an objective function over a fixed period of time.

Rather than presenting a detailed mathematical formulation of the model, a summary of the activities, constraints and objective function will be given.

Activities

The major activities, or variables, for which we are seeking a solution are the number of units of each industry to begin construction in each year of the planning horizon. That is, we are attempting to determine a construction timetable for coal gasification plants, coal mines, municipal services, etc., which optimizes the objective function. In addition, we are solving for the sizes of the three work forces, Navajo, permanent and migrant.

Constraints

The constraints relating to industries are these:

(1) Required labor force cannot exceed available labor.

(2) Natural resource utilization cannot exceed availability.

(3) Required capital must be available.

(4) Required output of each industry for each other must be met.

At this time, (4) is used in connection with the output of the coal mining industry and the need for coal. Also, (3) is being imposed only for supporting business and municipal service. In addition, the maximum numbers of coal gasification plants and electric power generation stations that can be constructed are 7 and 4, respectively.

The constraints relating to labor are these:

(5) Amounts of supporting business and municipal service must be sufficient for the "needs" of the (adjusted) labor force.

(6) Maximum fractional yearly decrease in each of the labor segments is limited by a constant related to the average lifetime in the community of members of the segments.

Objective Functions

The objective function we are using is the income to the Navajo Nation arising from royalities, land leases and salaries. Two other objective functions being considered are income to region and number of jobs for Navajos.

Implementation

All of our computing is done on a Control Data Corporation 6600 under the KRONOS time sharing system. The programs are in Fortran and we are using CDC's APEX-I to solve the LP's. The programs and data are on disk files, and we modify the files, execute the programs, and examine the data from a desk top terminal. Graphics output is available both at the terminal and from computer generated film plots.

ANALYSIS

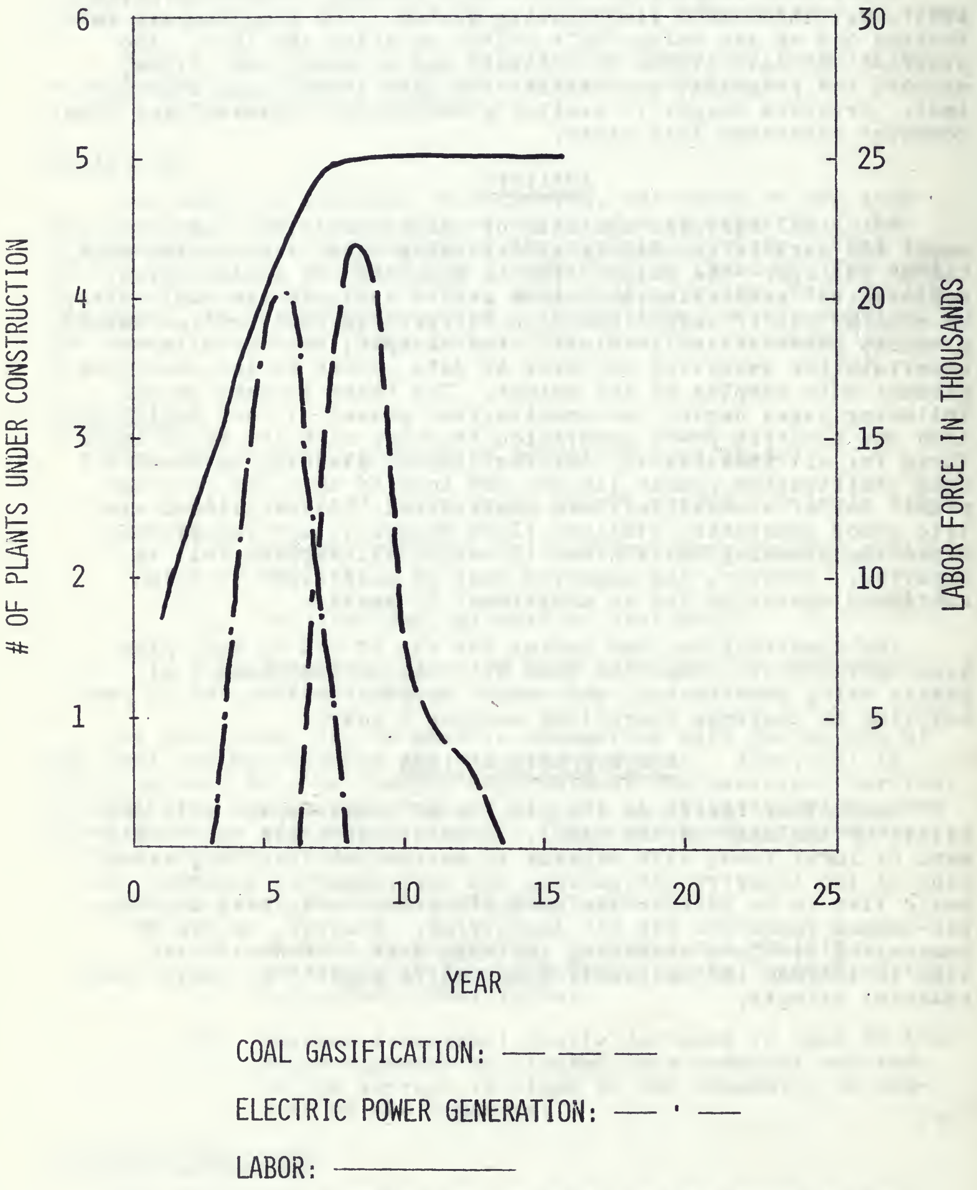
A typical exercise consists of making modifications to the model and data in the matrix generation program and running APEX, the LP package. The output APEX is processed by a code which performs the side calculations we use to evaluate the run. Also, we examine the LP output using an interactive plot routine which produces plots at the terminal. For example, because of many uncertainties involving the over 60 data inputs to the model, we present only samples of the output. The three figures on the following pages depict the construction phases of coal gasification and electric power generation together with the total labor force for all industries. For the 15 year planning horizon, 5.3 coal gasification plants (10,000,000 tons of coal per year per plant) out of a possible 7 are constructed. All 4 allowed electric power generation stations (1000 megawatt) are constructed. Since the planning horizon was 15 years, all surplus coal is exported. However, the exported coal is sufficient to allow continued operation for an additional 11 years.

The construction time tables for the 20 and 25 year planning horizons are about the same with the maximum number of plants being constructed, and enough surplus coal in the 20 year solution to continue operations another 5 years.

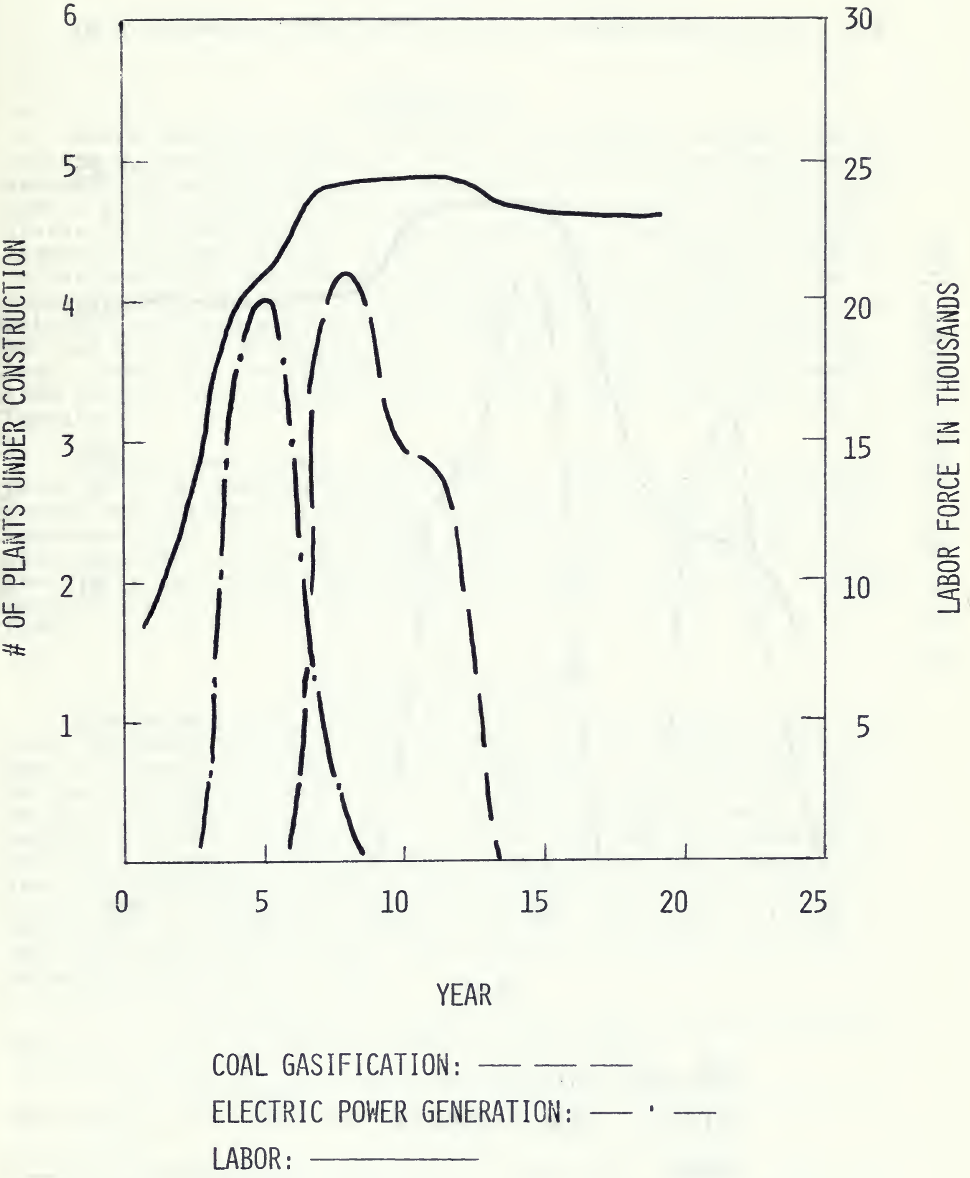
OTHER CONSIDERATIONS

Many other facets of the problem of local impact will certainly be included in the model. Some of these are the treatment of local labor with regards to on-the-job training, expansion of the industry categories, and environmental aspects. We would like to be able to use accurate production, cost and supply-demand functions for all industries. However, we are encountering problems acquiring reliable data. We would also like to include the currently qualitative aspects of social and cultural effects.

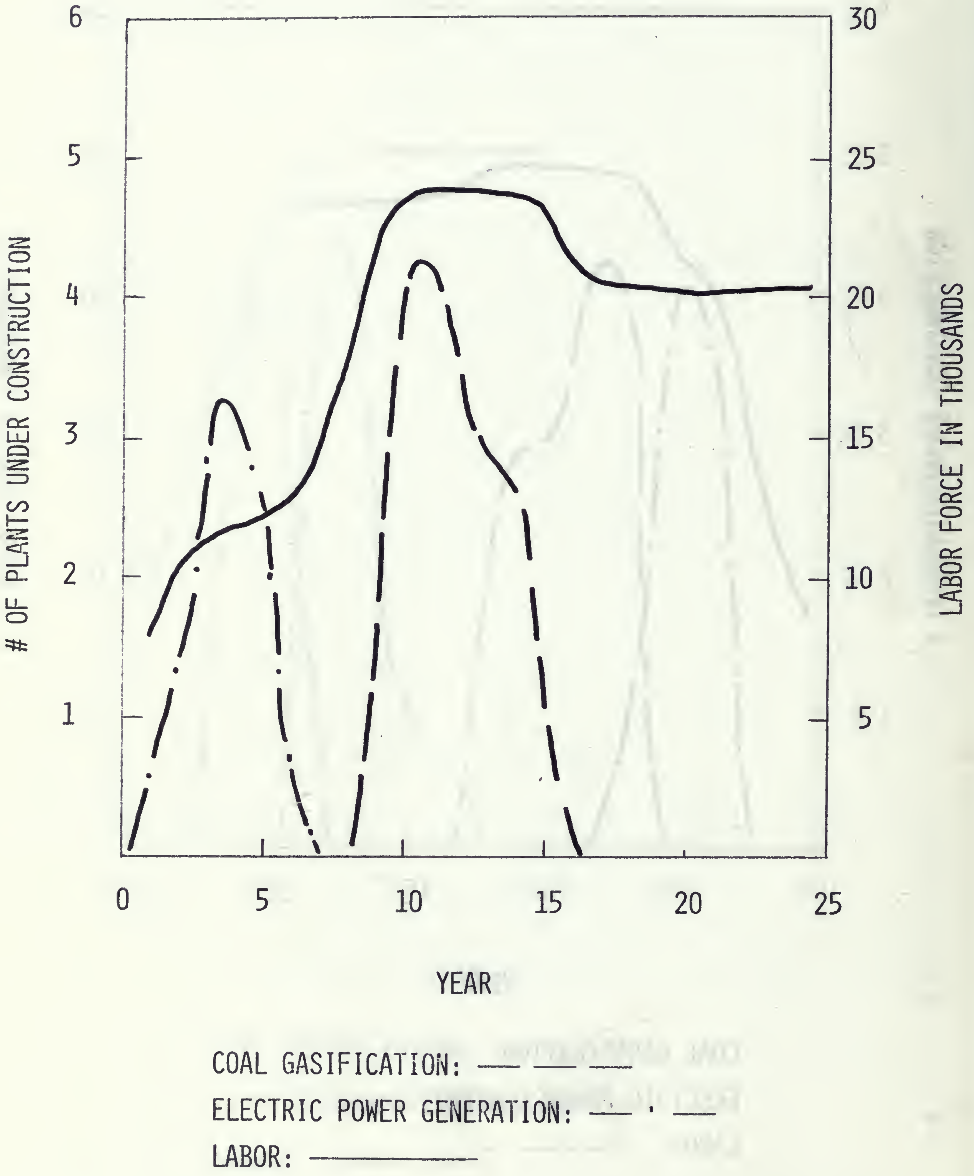
15 YEAR PLANNING HORIZON



20 YEAR PLANNING HORIZON



25 YEAR PLANNING HORIZON



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PROFILE OF NORTH DAKOTA'S COAL MINE AND ELECTRIC POWER PLANT OPERATION WORK FORCE

by

Arlen G. Leholm and F. Larry Leistritz*

INTRODUCTION

North Dakota's coal resources have recently become a major concern of state and national policy makers as a result of a national energy shortage. An abundance of low-cost energy has been a prime contributor to rapid economic growth in the United States, but low-cost nonpolluting energy is becoming a scarce resource in most states. As a result, lignite reserves located in western North Dakota are expected to play a major role in supplying needed energy to meet growing national needs. North Dakota's coal industry relying primarily upon "strip" mining methods may expand considerably over the remainder of this century. However, the prospect of expanded coal mining and conversion raises complex policy issues regarding natural and human resources.

Significant expansion of the coal industry poses such questions as: (1) Where will North Dakota get the manpower to construct and operate the plants and mines? (2) Where will the new employees live? (3) Will local people be able to fill some of the positions? (4) What skill requirements are necessary to run the plants and mines? This paper describes the profile of North Dakota's existing operation mine and electric power plant work force.

PURPOSE OF THE STUDY

Knowledge of the characteristics of the existing labor force in North Dakota's coal industry may be helpful in planning for the impact of expanded coal development. An understanding of the present work force characteristics may help provide answers to questions such as: (1) Will the immigrant work force prefer to live in communities near the new coal developments or will they prefer to live in larger communities and commute substantial distances to work? (2) How large will be the impact of the new work force on schools and other public services? This study provides information that can contribute to answers for questions of this type. This paper was written with the following objectives in mind:

1. To determine types of employment in North Dakota's coal mines and electric generating power plants.

2. To identify the socioeconomic characteristics of the existing coal industry work force.

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3. To determine employee earnings from present and previous employment, employee tenure, commuting patterns, and locational origin of the work force.

THE STUDY PROCEDURE

A mail survey of the operational work force in North Dakota's four major electric generating plants and three of the four major coal mines was conducted during the summer of 1974. Table 1 illustrates the power plants and coal mines included in the study, their productive capacities, the number of employees in each plant and mine, and the number of employees who answered the survey questionnaire. the study represents a 58 percent return of the questionnaire by the work force.

Power plants with less than 10 MW of electrical generating capacity and coal mines with less than one million tons of production per year were excluded from the study with one exception. The Knife River Coal Company's Gascoyne Mine was included, although not producing over 1,000,000 tons per year because of plans for rapid expansion to fuel the Big Stone Plant near Milbank, South Dakota. All of the major power plants and coal mines are located in southwest North Dakota. The exact location of

TABLE 1. POWER PLANT AND COAL MINE EMPLOYEES, LOCATION, PRODUCTION, AND EMPLOYEES ANSWERING WORKER PROFILE SURVEY

Power Plant or Coal Mine	Number of Employees[a]	Employees Answering Survey	Production[b]	County Located
R. M. Heskett Plant (Montana Dakota Utilities)	45	20	100 MW	Morton
Leland Olds Plant (Basin Electric Power Coop)	47	31	215.7 MW	Mercer
Stanton Plant (United Power Cooperative)	53	24	172 MW	Mercer
Milton R. Young Plant (Minnkota Power Co-op)	42	16	234.6 MW	Oliver
Beulah Mine (Knife River Coal Co.)	69	69	1,585,769 tons	Mercer
Gascoyne Mine (Knife River Coal Co.)	37	37	182,161 tons	Bowman
Glen Harold Mine (Consolidation Coal Co.)	73	14	1,327,314 tons	Mercer
Indianhead Mine (North American Coal Co)	50	30	1,049,416 tons	Mercer
Total	416	241		

[a] Number of employees in June, 1974.

[b] Power plant nameplate capacity and fiscal year 1973 coal production, respectively.

SOURCE: State Coal Mine Inspector, Coal Mine Inspection Department, Biennial Reports, State of North Dakota, Bismarck, 1973.

major power plants and mines in North Dakota is illustrated in Figure 1.

GENERAL SOCIOECONOMIC CHARACTERISTICS

The 241 employees who completed the survey were 99 percent Caucasian; 93 percent were males and their average age was 37 years ranging from 18 to 67 years. Over 87 percent of the employees were married. The employees had an average of 1.8 children living at home. Over 86 percent of the employees were born in North Dakota.

Table 2 indicates that 44.4 percent of the employees lived in a city between 1,000 and 2,500 population, 15.8 percent lived in cities under 500 population, and 13.3 percent lived on farms.

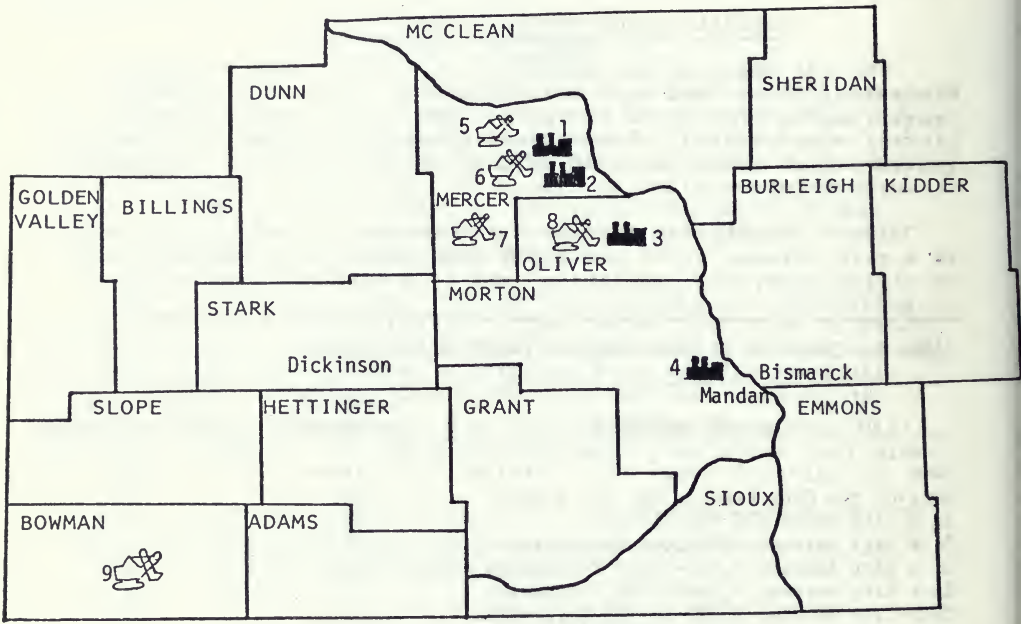
TABLE 2. LOCATION OF COAL INDUSTRY EMPLOYEE RESIDENCES

Type of Residence	Number of Employees	Percent of Total Employees
Farm	32	13.3
Outside the City Limits, but not a Farm	15	6.2
In a City Under 500 Population	38	15.8
In a City Between 500-1,000 Population	27	11.2
In a City Between 1,000-2,500 Population	107	44.4
In a City Between 2,500-5,000 Population	4	1.7
In a City Between 5,000-10,000 Population	0	0.0
In a City Over 10,000 Population	16	6.6
No Answer	2	0.8
Total	241	100.0

The employees have lived an average of 22 years in the community in which they now live, which may indicate a high percentage of the existing coal industry work force is hired from the local labor force. The current coal industry work force population is very stable, over 45 percent of the employees have resided at their current address more than 10 years (Table 3). Furthermore, most of the employees who had lived in another community had moved to their present community from another North Dakota county. Over 67 percent of the employees owned their own houses, while another 14.7 percent owned a mobile home. Over 15 percent of the employees rented a house, an apartment, or a mobile home.

TABLE 3. YEARS LIVED AT PRESENT ADDRESS

Number of Years	Number of Employees	Percent of Total
Less than 1 Year	37	15.4
1 to 3 Years	33	13.7
4 to 5 Years	21	8.7
5 to 10 Years	40	16.6
More than 10 Years	109	45.2
No Answer	1	.4
Total	241	100.0



1.	United Power Cooperative	172.0 megawatts
2.	Basin Electric Power Cooperative	215.7 megawatts
3.	Minnkota Power Cooperative	234.6 megawatts
4.	Montana Dakota Utilities	100.0 megawatts
5.	North American Coal Co. (Indianhead Mine)	1,049,416 tons
6.	Consolidation Coal Co. (Glen Harold Mine)	1,327,314 tons
7.	Knife River Coal Co. (Beulah Mine)	1,585,769 tons
8.	Baukol-Noonon, Inc. (Center Mine)	1,563,446 tons
9.	Knife River Coal Co. (Gascoyne Mine)	182,161 tons

FIGURE 1. MAJOR POWER PLANTS AND LIGNITE MINES IN NORTH DAKOTA, 1974[a]

[a] Coal production tonnage is for the year 1973.

PRESENT EMPLOYMENT CHARACTERISTICS

Job descriptions for the North Dakota coal industry were condensed into nine categories. The categories are defined as follows:

1. Yard operator or car spotter--one who is employed at the tipple and lines up coal cars for loading and performs other miscellaneous tasks.

2. Dragline or shovel operators and oilers--dragline operator is one who operates an electric dragline in the removal of overburden in strip mines or operates a coal loading shovel. A dragline oiler provides maintenance to the dragline and assists the operator.

3. General laborer--one who works at the mine or power plant performing any combination of tasks, such as cleaning working areas, painting, or as a general handyman.

4. Mechanics, welders, carpenters--one who performs a maintenance function on coal mine or power plant equipment.

5. Electricians, engineers, boiler attendants--one who is skilled in electronics or engineering and works in this capacity at either the coal mine or power plant.

6. Accountants and office personnel--one who performs record keeping, accounting, and general office functions for the coal or power companies.

7. Managers and foremen--one who performs a supervisory or managerial function and is responsible to various degrees for the overall operation of the coal mines or power plants.

8. Dozer operator and truck driver--one who operates power equipment used in the removal of overburden and the reclamation process. One who drives a vehicle used in moving or replacing overburden, coal, or other material.

9. Miscellaneous--one who performs a wide array of tasks. Included in this category are coal shooters, night watchmen, and other miscellaneous workers.

Table 4 indicates the number of employees in each of the nine job classifications. General laborer was the largest job classification with 19.1 percent of the employees, followed by dozer operators and truck drivers with 17 percent, and managers and foremen with 16.6 percent of the work force.

JOB CLASSIFICATION

Yearly Earnings

Almost 40 percent of all coal industry employees had yearly earnings between $11,000 and $12,999 (Table 5.) Approximately two-thirds of all coal industry employees had earnings above $11,000. The dragline operator category had the highest percentage, 93.3 percent, of its employees with earnings over $11,000. The accountant and office personnel category had only 26.7 percent of its employees earning more than $11,000. The manager and foreman

TABLE 4. NORTH DAKOTA COAL INDUSTRY JOB CLASSIFICATION

Job Classification	Number of Employees	Percent of Total
Yard Operator or Car Spotter	15	6.2
Dragline or Shovel Operator and Dragline Oiler	16	6.7
General Laborer	46	19.1
Mechanics, Welders, Carpenters	29	12.0
Electricians, Engineers, Boiler Attendants	20	8.3
Accountants and Office Personnel	15	6.2
Managers and Foremen	40	16.6
Dozer Operators and Truck Drivers	41	17.0
Miscellaneous	19	7.9
Total	241	100.0

job classification had the highest percentage of employees (37.8 percent) earning $15,000 or more. The miscellaneous job category had 60 percent of its employees earning less than $9,000, but this includes a substantial number of part-time workers. Managers and dragline operators stood at the top in terms of yearly earnings; whereas, office personnel and miscellaneous employees had the lowest yearly earnings in the coal industry.

Coal industry earnings are apparently quite independent of formal education. Approximately 28 percent of those employees in the $11,000 to $12,999 income category had eight years or less of formal education, and only 17.8 percent of the employees with earnings between $11,000 and $12,999 had formal education beyond high school. However, a college education appeared highly related with incomes above $17,000. This no doubt reflects top management positions in the coal industry.

Education and Vocational Training

Approximately 42 percent of all coal employees terminated their formal education after 12 years (Table 6). The manager category, electrician and engineer category, and the accountant category had the highest percentage of employees with 16 or more years of education. Mechanics, welders, carpenters, dozer operators, and truck drivers had high percentages of their employees with eight years or less of formal education. Table 6 reveals many job classifications in the coal industry do not require a great deal of formal education. However, over 82 percent of the mechanic, welder, and carpenter category employees had some vocational training. There is also an apparent tendency for on-the-job training with the company. For example, only 17 percent of the dragline operators had vocational training and only 19 percent of the dozer operators and truck drivers had vocational training; although for an employee to perform well in these job classifications may require extensive job training.

Age

Approximately 82 percent of all coal industry employees were 47 years of age or younger (Table 7). However, over 43

TABLE 5. YEARLY EARNINGS OF COAL INDUSTRY EMPLOYEES BY JOB CLASSIFICATION[a]

	Earning Categories											
	Less Than $9,000		$9,000-$10,999		$11,000-$12,999		$13,000-$14,999		Over $15,000		Total	
Job Classification	No.	% of Row Total	No.	% of Row Total	No.	% of Row Total	No.	% of Row Total	No.	% of Row Total	Row Total	Percent
Yard Operator or Dragline Spotter	0	0.0	5	41.7	4	33.3	3	25.0	0	0.0	12	5.5
Dragline Operator or Dragline Oiler	0	0.0	1	6.7	5	33.3	8	53.3	1	6.7	15	6.8
General Laborer	10	21.7	19	41.3	16	34.8	1	2.2	0	0.0	46	20.9
Mechanics, Welders, Carpenters	1	3.5	3	10.3	16	55.2	8	27.6	1	3.5	29	13.2
Electricians, Engineers, Boiler Attendants	1	5.3	3	15.8	7	36.8	6	31.6	2	10.5	19	8.6
Accountants and Office Personnel	7	46.7	4	26.7	3	20.0	0	0	1	6.7	15	6.8
Managers and Foremen	2	5.4	3	8.1	9	24.3	9	24.3	14	37.8	37	16.8
Dozer Operators, Truck Drivers	1	2.7	7	18.9	24	64.9	4	10.8	1	2.7	37	16.8
Miscellaneous	6	60.0	1	10.0	3	30.0	0	0.0	0	0.0	10	4.6
Total	28	12.7	46	20.9	87	39.6	39	17.7	20	9.1	220	100.0

[a] The "no answers" and "do not know" responses were excluded from the analysis.

TABLE 6. EDUCATION OF COAL INDUSTRY EMPLOYEES BY JOB CLASSIFICATION[a]

	Years of Education											
	8 Years or Less		9-11 Years		12 Years		13-15 Years		16 or More Years		Total	
Job Classification	No.	% of Row Total	No.	% of Row Total	No.	% of Row Total	No.	% of Row Total	No.	% of Row Total	Row Total	Percent
Yard Operator and Coal Spotter	3	20.0	6	40.0	5	33.3	1	6.7	0	0.0	15	6.7
Dragline Operator or Dragline Oiler	4	25.0	2	12.5	7	43.8	3	18.8	0	0.0	16	7.1
General Laborer	6	13.3	4	8.9	25	55.6	8	17.8	2	4.4	45	20.1
Mechanics, Welders, Carpenters	10	35.7	1	3.6	11	39.3	5	17.9	1	3.6	28	12.5
Electricians, Engineers, Boiler Attendants	0	0.0	0	0.0	9	45.0	4	20.0	7	35.0	20	8.9
Managers and Foremen	4	10.0	4	10.0	17	42.5	7	17.5	8	20.0	40	17.9
Accountants and Office Personnel	0	0.0	0	0.0	5	33.3	6	40.0	4	26.7	15	6.3
Dozer Operators, Truck Drivers	16	44.4	1	2.8	14	38.9	1	2.8	4	11.1	36	16.1
Miscellaneous	4	44.4	0	0.0	2	22.2	3	33.3	0	0.0	9	4.0
Total	47	21.0	18	8.0	95	42.4	38	17.0	26	11.6	224	100.0

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[a] The "no answer" and "do not know" categories were excluded from the analysis.

percent of the dragline operators were over 48 years of age, which may indicate much experience and knowledge is required to operate a dragline. The managers and foremen category had 30 percent of its employees over 48 years of age. The electrician and engineer category had the highest percentage (63.2 percent) of its employees in the 18 to 27 age category. Many of the electricians and engineers are required to have at least some college training which may help explain why they are relatively young compared to employees in most other job classifications. Only 4.4 percent of the general laborer category employees were over 48 years of age. The general laborer category may have job requirements requiring very strenuous activity, which would explain the very high percentage of young employees.

Number of Years Employed by Coal Industry Company

Approximately 30 percent of all coal industry employees have worked less than one year with their present company. Managers, dozer operators, truck drivers, and dragline operators have a longer tenure with their present company than other job classifications. This seems to indicate a considerable degree of promotion from within the company. Employees in the general laborer category had the largest percentage of employees who had been employed less than one year. The North Dakota coal industry has a relatively stable work force with over 50 percent of the industry employees having been employed five years or more with their present company.

Number of Previous Positions With Present Coal Company

One indication of the internal promotion policy of any company is the number of previous positions its employees have had with that company. Dragline operators have held more positions with their present company than any other job classification. Over 63 percent of the dragline operators have held four or more positions with their present company. Many of the managers and foremen also have held more than one job position with their present company. Approximately 44 percent of the total surveyed work force have held no other position other than their current position with their present company.

Job Satisfaction of Coal Industry Employees

The coal industry employees have indicated a high degree of satisfaction with their jobs. Employees were asked to rate their job satisfaction by choosing one of five possible responses: very satisfied, satisfied, so-so, unsatisfied, and very unsatisfied. Assigning a satisfaction rating of five points to "very satisfied," four points for "satisfied," three points to "so-so," and two points for "unsatisfied,"--the job satisfaction rating for all employees was 4.21 out of the possible five points. It is significant to note that no employee indicated that he was very unsatisfied with his job. It is interesting to note that the employees who were born out of state expressed a higher degree of satisfaction with their employment than employees who were born in North Dakota. The employees born out of state had a job satisfaction rating of 4.35 out of a possible five points. This compares to a job satisfaction rating of 4.12 out of a possible five points for employees born in North Dakota.

TABLE 7. . PRESENT AGE OF COAL INDUSTRY EMPLOYEES BY JOB CLASSIFICATION[a]

	Age Categories											
	18-27		28-37		38-47		48-57		58-67		Total	
Job Classification	No.	% of Row Total	No.	% of Row Total	No.	% of Row Total	No.	% of Row Total	No.	% of Row Total	Row Total	Percent
Yard Operator and Car spotter	2	13.3	6	40.0	5	33.3	1	6.7	1	6.7	15	6.4
Dragline Operator or Dragline Oiler	1	6.3	1	6.3	7	43.8	3	18.8	4	25.0	16	6.9
General Laborer	22	47.8	13	28.3	9	19.6	2	4.4	0	0.0	46	19.7
Mechanics, Welders, Carpenters	4	13.3	9	30.0	11	36.7	4	13.3	2	6.7	30	12.9
Electricians, Engineers, Boiler Attendants	12	63.2	3	15.8	4	21.1	0	0.0	0	0.0	19	8.2
Managers and Foremen	6	15.0	11	27.5	11	27.5	7	17.5	5	12.5	40	17.2
Accountants and Office Personnel	9	60.0	3	20.0	2	13.3	1	6.7	0	0.0	15	6.4
Dozer Operators, Truck Drivers	5	12.2	12	29.2	14	34.2	5	12.2	5	12.2	41	17.6
Miscellaneous	5	45.5	1	9.1	2	18.2	2	18.2	1	9.1	11	4.7
Total	66	28.3	59	25.3	65	27.9	25	10.7	18	7.7	233	100.0

[a] The "no answer" and "do not know" responses were excluded from the analysis.

Distance Commuted to Work

Approximately 72 percent of all coal employees traveled 10 miles or less to their location of work. Only 7.8 percent of all coal industry employees commuted over 21 miles to their work location. This indicates the current North Dakota coal industry employees reside within relatively short distances from their place of work. Workers in the electrician and engineer job category commuted considerably further to work than the average of all coal industry employees.

There is an inverse relationship between the number of miles the coal employees traveled to work and job tenure with their present company. Those employees that have worked less than one year for their present company commuted substantially longer distances to work than employees with 20 years or more of job tenure. Employees with shorter job tenure apparently prefer to live in a larger city and commute greater distances to work than employees with over 20 years of job tenure.

Over 71 percent of the coal industry employees commuted to work in their own private car, 24.1 percent commuted by car pool, and 4.6 percent by other means of transportation. The average distance traveled to work by all coal industry employees was 9.2 miles with a range from less than one mile to just over 100 miles.

Years Resided in Present Community

Over 50 percent of all coal industry employees have lived in their present community more than 20 years. Two job classification categories--electricians and engineers, accountants and office personnel--have a high percentage of employees who have resided less than one year in the community. In each other job category at least 48 percent of the employees had resided over 10 years in the community. The North Dakota coal industry has obviously recruited most of its employees from the local community with the exception of electricians, engineers, and office personnel.

Previous Residence of Coal Industry Employees

Only 15 percent of the industry employees had previously resided out of state; however, 30 percent of the electricians and engineers category and 27.5 percent of the manager and foremen personnel were recruited from out of state. Over 50 percent of the coal industry employees' previous residence was within the county of their present residence, 36.8 percent of which had no previous residence. With the exception of the manager category and electrican and engineer category, at least 80 percent of the employees from all other employment categories were from within the state of North Dakota. However, 50 percent of the employees earning over $17,000 and 38.4 percent of the employees earning between $15,000 and $16,999 were previously located out of state. This seems to indicate an importation of high-level management from out of state.

PREVIOUS EMPLOYMENT CHARACTERISTICS

Of the 241 respondents, 194 employees had worked for another employer. General laborer was the previous employment category for 33 percent of the employees. Another 21.1 percent were equipment operators; while 17 percent were mechanics, welders, and carpenters, and an additional 15 percent of the employees' previous employment was office or management related. Over 18 percent of the employees' previous employment was out of state and 2.5 percent was in some other location (e.g., in a foreign country). Present coal company employees worked an average of four years for their previous employer and they traveled an average of 18.8 miles to work. A higher salary and better working conditions were the reasons given by over 50 percent of the present employees for leaving their previous employer. The average salary differential between the ending salary of the previous employer and the starting salary of the present employment was $2,302. Approximately 92 percent of the employees received a net pay increase, while 8 percent had a net pay decrease.

COMPARISON OF COAL MINE AND POWER PLANT EMPLOYEES

The coal mine and power plant employees have many similar socioeconomic characteristics. However, there are some notable differences in their work force profiles. Approximately 49 percent (91 employees) of the power plant work force and almost 66 percent (150 employees) of the coal mine work force responded to the survey questionnaire. The age of the coal mine and power plant workers averaged 37.1 years and 36.2 years, respectively. The power plant workers had an average of 2.1 children living at home compared to 1.6 children for the coal mine employees. The coal mine employees have lived an average of 7.7 years longer in their present community than the power plant workers and have worked 9.1 years with their present company compared to 8.0 years for the power plant employees. However, the power plant employees had worked an average of 10 months longer for their previous employer.

Virtually the same percentage (87 percent) of employees in the coal mine and power plant work forces were married. Approximately 87 percent of the two work forces were born in North Dakota, but a higher percentage of the coal mine workers (44.3 percent compared to 26.4 percent of the power plant employees) have always lived in the community where they currently reside. There were no appreciable differences in type of home ownership between the two work forces. However, a greater percentage of the coal mine employees have resided 10 years or more at their present address.

The power plant employees have more formal education and a higher percentage of them have had some vocational training. The salary increase between the coal industry employees starting salary with their previous employer averaged $2,540 for the coal mine employees and $1,803 for the power plant employees. The median income for the power plant employees was between $11,000 and $11,999; whereas, the median income of the coal mine employes was between $12,000 and $12,999. Almost 72 percent of the coal mine employees earned over $11,000, this compares to 59 percent of the power plant employees earning over $11,000 per year. Comparing the job satisfaction rating on a five-point scale, the coal mine employees ranked their job satisfaction 4.27 out of a possible five points, while the power plant employees ranked their job satisfaction 4.06 out of a possible five points.

A notable difference in the two work forces means of travel to work was revealed in the study. Over 50 percent of the power plant employees commuted to work by use of a car pool, this compares to only 8 percent of the coal mine employees using a car pool to travel to work. The power plant employees averaged12.6 miles to their place of work and the coal mine employees averaged 7.1 miles to their work location.

IMPLICATIONS OF THE STUDY

This study of the current coal industry work force indicates the coal industry does not require a highly formally educated work force; 72 percent of the current work force had 12 years or less of formal education. Furthermore, many of the current employees received on-the-job training and a considerable degree of internal promotion is evident for the very skilled jobs, such as dragline operators. It is quite likely a rural labor force, with basic mechanical skills acquired from a farm background, would make good recruits for manpower expansion in the coal industry.

Perhaps one indication of the characteristics that may be associated with the work force that will immigrate to the coal development areas to meet the expansion of the coal industry is provided by the characteristics of the current workers who have been employed five years or less with their present company. Employees who have worked five years or less with their present company are characterized by a much higher level of formal education than longer tenured employees and commute substantially longer distances to work. Employees with shorter job tenure apparently prefer to live in a larger city and commute greater distances to work than employees with longer job tenure.

Expansion of the coal industry may provide employment opportunities for the local labor force. The industry does not require a highly formally trained work force,although many of the jobs are skilled positions. Vocational training in electronics, mechanics, welding, and similar skills would enhance job opportunities for local people. There will also be a large increase in employment created indirectly as a result of expanded coal development. This secondary employment includes trade and service jobs to meet the needs of the coal industry work force and their families. Employment will also be created in areas of reclamation and economic and community planning to meet the challenge of an expanding population.

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ECONOMIC IMPACT OF COAL DEVELOPMENT IN WESTERN NORTH DAKOTA

Norman L. Dalsted, F. Larry Leistritz,
and Thor A. Hertsgaard*

INTRODUCTION

We are all quite familiar with the prospects of coal-energy development in the Northern Great Plains Region. Presently, industrial energy development is taking place in ever increasing proportions in Montana, North Dakota, and Wyoming. An awareness has been generated in the populace of the affected coal development areas, as well as in the states themselves. Questions arising regarding the consequences or possible impacts on the region are constantly posed by state and local leaders, legislators, citizens, and industry representatives.

The Northern Great Plains Resources Program was established in an effort to answer and quantify what the effects and impacts could be in the region. The three federal agencies designated to lead the study effort were the Department of Interior, Department of Agriculture, and the Environmental Protection Agency. The study was an immense undertaking involving many federal and state agencies, university, industry, and private groups.

The program was structured under seven major group headings. The seven work groups were National Energy Considerations, Regional Geology, Mineral Resources, Water, Atmospheric Aspects, Surface Resources, and Socioeconomic and Cultural Aspects. Much of the research accomplished was interrelated; thus, the program was a major effort not only in terms of research and data compilation, but in terms of coordination. The program not only generated a wealth of information, but created many ties between agencies, groups, and individuals which did not previously exist. This paper presents research conducted by North Dakota State University, which was initiated under the auspices of the Socioeconomic and Cultural Aspects Work Group.

NORTHERN GREAT PLAINS RESOURCES PROGRAM

Study Area

The Northern Great Plains Resources Program involved five states (Montana, Nebraska, North and South Dakota, and Wyoming). The study area included portions of the five aforementioned states, with the areas outlined in Montana, North Dakota, and Wyoming being the "Principal Impact Areas" (i.e., where the coal-energy developments were sited). The principal impact areas (PIA's) were used primarily by the Socioeconomic and Cultural Aspects Work Group for analytical purposes (Figure 1).

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Coal Development Profiles

To facilitate the assessment of environmental, economic, and social impacts of coal-energy development in the Northern Great Plains States, the National Energy Considerations Work Group of the Northern Great Plains Resources Program prepared three alternative profiles of future coal-energy development in the area. The coal development profiles (CDP's) were developed for study purposes only and do not constitute either a forecast of future energy development or a plan for energy development in the Northern Great Plains States. They do provide a framework for analysis of the effects of alternative levels and types of development.

The National Energy Considerations Work Group developed projections of the overall level of energy development in the three basic categories of export mining (mining of coal for shipment out of the state), electric power generation, and gasification (production of synthetic natural gas from coal). The development in each category was then allocated among the states. Subsequently, the U.S. Bureau of Mines personnel specified appropriate sites for the various developments based upon the location of major coal deposits, the availability of water, and certain other factors. The development of the CDP's was discussed in detail in the reports of the National Energy Consideration Work Group and the Mineral Resources Work Group.

The Coal Development Profiles (CDP's) were defined as follows:

CDP I (Base Scenario)--is defined as no development of coal resources other than those necessary to meet regional demand andpreviously committed demand.

CDP II (Probable Scenario)--is defined as the level of coal development likely to occur embodying large coal-fired generating plants, coal conversion plants, and out-of-state exports of coal, particularly to electrical generation sectors of the market area.

CDP III (Extensive Scenario)--is defined as a national crisis situation with major reductions in oil imports, major restrictions in natural gas imports from Canada, and major lags in nuclear generating capacity.

The various coal-energy developments prepared are located in Table 1 by CDP, by state, by type, and by year. It should be noted that South Dakota and Nebraska did not have any coal developments scheduled, but these states were included in the NGPRP because of their proximity to the proposed coal-energy developments. CDP III (extension scenario) indicates 41 gasification facilities, 11 electrical power generation complexes, and 51 export mines located in the three states by the year 2000. Coal production would approach one billion tons per year by 2000 under CDP III as compared to 360 million tons and 140 million tons for CDP I and CDP II, respectively, for the year 2000.

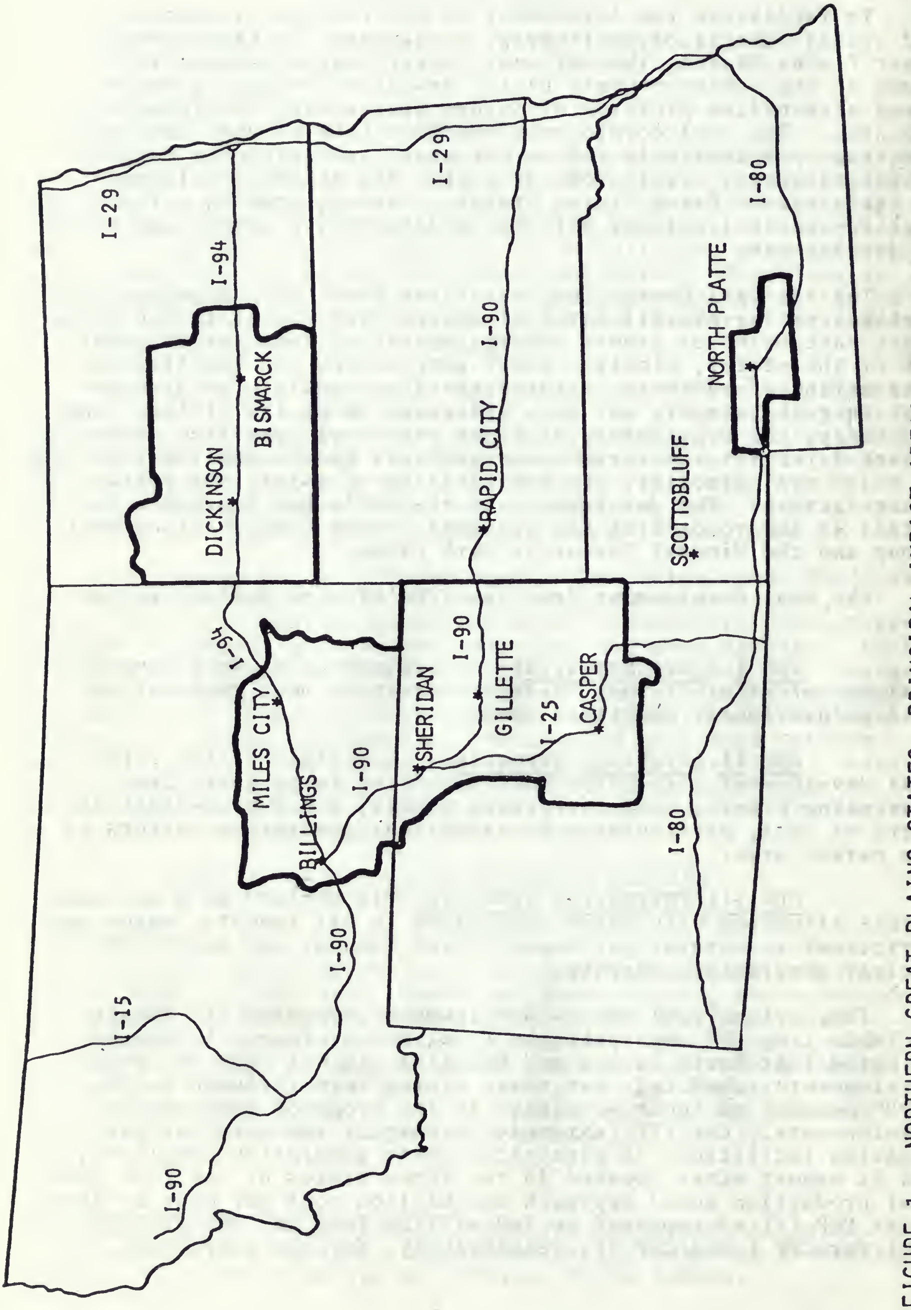

FIGURE 1. NORTHERN GREAT PLAINS STATES, PRINCIPAL IMPACT AREAS, INTERSTATE HIGHWAY SYSTEM, AND MAJOR CITIES

TABLE 1. THE COAL ENERGY DEVELOPMENT FACILITIES IMPLEMENTED BY COAL DEVELOPMENT PROFILE, BY TYPE AND BY YEAR FOR MONTANA, NORTH DAKOTA, AND WYOMING

	Year								
	1980			1985			2000		
CDP	Export Mines[a]	Electric Generation[b]	Gasification[c]	Export Mines[a]	Electric Generation[b]	Gasification[c]	Export Mines[a]	Electric Generation[b]	Gasification[c]
CDP I									
Montana							1	4	
North Dakota							1	1	
Wyoming							1	1	
CDP I Total	0	0	0	0	0	0	3	6	0
CDP II									
Montana	1			2		3	2	4	3
North Dakota				1		2	1	6	5
Wyoming	1			1		2	2	1	1
CDP II Total	2	0	0	4	0	7	5	11	9
CDP III									
Montana	1		3	5		5	17	4	7
North Dakota			4	1		2	2	6	11
Wyoming	1			5		6	19	1	3
CDP III Total	2	0	7	11	0	13	38	11	21

[a] Export mines vary in size from 2.0 - 10.0 million tons per year.

[b] Montana - 1,025 megawatt facilities, North Dakota - 1,250 megawatt facilities, and Wyoming - 1,200 megawatt facilities.

[c] Gasification plants are 250 mmcfd facilities.

NORTH DAKOTA ANALYSIS

The specific purpose of this paper is to estimate the impact on gross business volume, employment, and population associated with various levels of prospective coal resource development in western North Dakota. The three alternative assumed levels of coal development developed were used as the basis for analysis.

North Dakota Study Area

The coal mines, power plants, and coal converison complexes which soon may be developed in North Dakota will be located primarily in the section of the state lying south and west of the Missouri River. Therefore, the study area was defined as North Dakota State Planning Regions 7 and 8, which encompass roughly the southwestern quarter of the state (Figure 2). The 18-county study area contains more than 80 percent of the state's strippable coal (lignite) reserves (1).

The economy of the 18-county study area presently is heavily oriented toward agriculture. Agriculture is the dominant land use in the area, with more than 95 percent of the land being included in farms (4). Dryland crops and range livestock are the primary enterprises. An important trend in recent years has been a decline in the number of farms and ranches, which in turn has resulted in a decline in agricultural employment. Between 1960 and 1970 agricultural employment decreased by 37 percent in the study area (5). The decline in agricultural employment has been the key factor leading to a general population decline. Between 1960 and 1970 the population of the study area declined 3.9 percent. Of the 18 counties in the study area, 16 experienced a population decrease during the decade of the 1960's.

Historically, the area has experienced income levels considerably below the national average and a high rate of net outmigration. Per capita money income in the area in 1969 was only 74 percent of the national average (6). During the decade of the 1960's the area's net out-migration amounted to 26,651 persons or 17.4 percent of the 1960 population (7). Local and state leaders are interested in means to halt these trends, but also are concerned that massive coal development may impose substantial social costs on area residents.

The Model

An input-output model of southwestern North Dakota was employed to analyze the impacts of alternative levels of development. Expenditure data for 1965 had been collected by personal interviews with individual firms and households and incorporated into a 30-sector, input-output (I-O) model to develop interdependence coefficients (2). These coefficients were subsequently tested for validity (3). Experience in application of the I-O model has indicated that the original 30-sector model contains more sectors than are needed and may lead to confusion regarding sector definition for users of the results. Accordingly, the original 30 sectors were consolidated into 13 sectors. The sectors are agriculture - livestock production; agriculture - crop production; mining; contract construction; transportation;

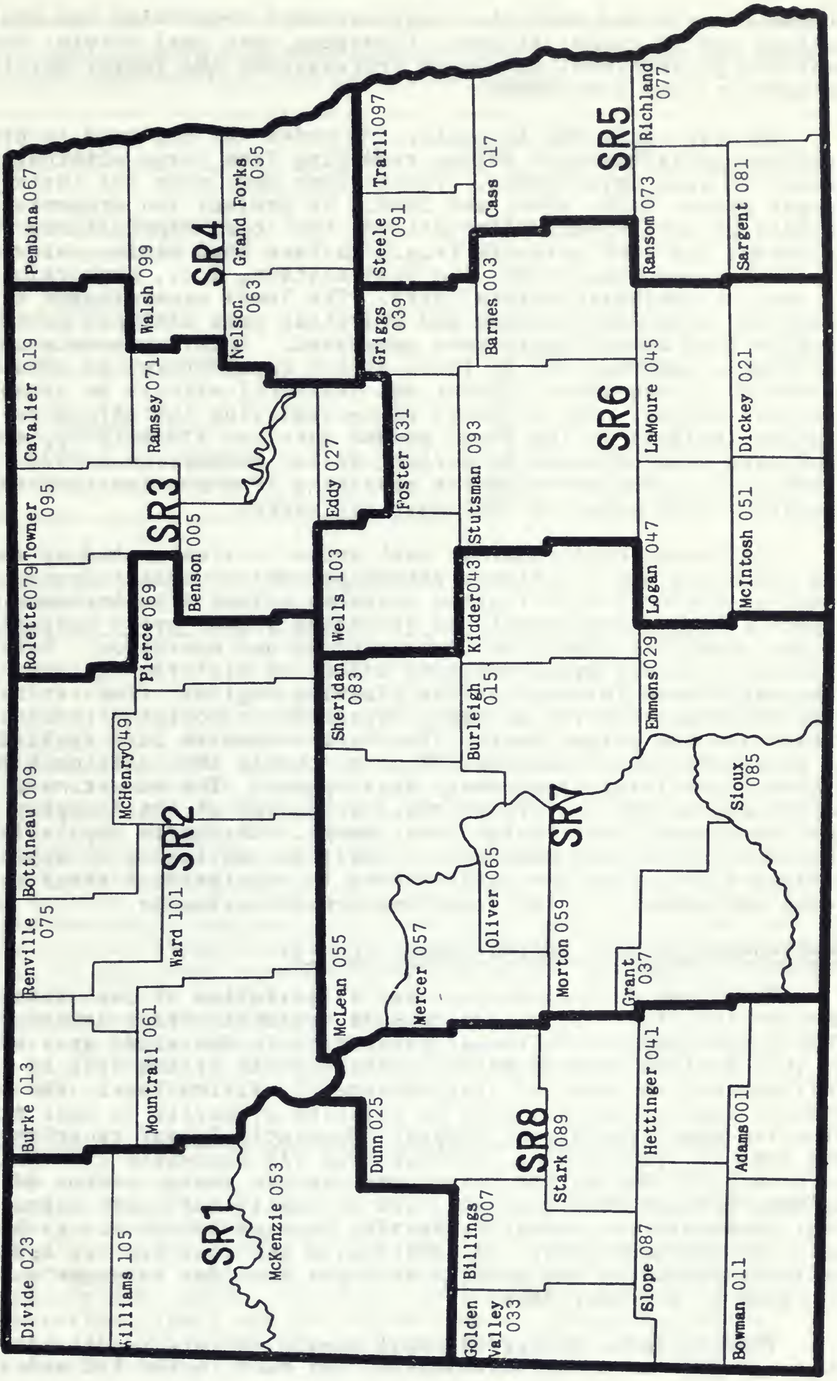

FIGURE 2. NORTH DAKOTA STATE PLANNING REGIONS

communications and utilities; agricultural processing and wholesaling; retail trade; finance, insurance, and real estate; business and professional services; professional and social services; households; and government.

In this study the 13-sector I-O model was employed to project the gross business volume resulting from three alternative levels of coal development. Projections were made for three target years--1980, 1985, and 2000. To project the economic impacts of development alternatives, the local expenditures were estimated for each activity (e.g., surface coal mining, steam-electric power generation; and gasification, i.e., conversion of coal to synthetic natural gas). The local expenditures for plant and mine construction and operation were assigned to the sectors from which inputs were purchased. Interdependence coefficients were applied to these direct expenditures to obtain estimates of the total (direct and indirect) effects on gross business volume. For purposes of neutralizing the effect of inflation implicit in the final demand data set (1958-1973), the base data were adjusted to reflect dollar volumes on a 1972 price basis. The expenditures resulting from construction and operation were based on 1972 cost estimates.

Additional employment in each sector was estimated by applying projected gross business volume per worker ratios (projections of historic sector gross business volume ÷ projections of historic sector employment) to projected sector gross business volume resulting from plant construction and operation. Ratios relating historic gross business volume to historic employment were calculated for each of the planning regions. The ratios were extra-polated via multiple regression to obtain projected ratios for the target years. The ratios were in turn applied to projected gross business volume to obtain the additional employment resulting from energy development. The summation of employment in the sectors provided estimates of total employment attributable to energy development. Change in population associated with each development level was estimated by applying projected participation rates (trend in population ÷ trend in total employment) to the total employment estimates.

Development to Meet Region Demand (CDP I)

The first policy analyzed was a limitation of coal development to that level necessary to meet regional energy demand. This policy implies that coal production in the study area will be 19.3 million tons annually in 1980 (Table 2) compared to a 1974 production level of slightly over 7 million tons. The increased coal production will be utilized primarily to fuel steam-electric power generating plants. Generating plant capacity in the area was expected to increase from 736 megawatts (MW) in 1972 to 2,533 MW in 1980. No change in the energy sector was assumed between 1980 and 1985, but an additional 1,200 megawatt (MW) steam-electric power generating complex is assumed to be built by the year 2000. In addition, a new coal mine is assumed to be producing two million tons per year for shipment out of state by the year 2000.

The projected change in final demand vectors resulting from these changes in energy development was used in the I-O model

TABLE 2. COAL PRODUCTION AND RELATED ENERGY ACTIVITY ASSOCIATED WITH THREE COAL DEVELOPMENT PROFILES, SOUTHWESTERN NORTH DAKOTA

Item	Year			
	1974	1980	1985	2000
CDP I				
Coal Production (MMTPY)[a]	7.2	19.3	19.3	28.6
Electrical Generation (MW)[b]	735.8	2,533.0	2,533.0	3,733.0
CDP II				
Coal Production (MMTPY)	7.2	19.3	42.5	135.7
Electrical Generation (MW)	735.8	2,533.0	2,533.0	10,033.0
Coal Gasification (MMCFD)[c]	0	0	500.0	1,750.0
CDP III				
Coal Production (MMTPY)	7.2	59.5	83.2	249.7
Electrical Generation (MW)	735.8	2,533.0	2,533.0	10,033.0
Coal Gasification (MMCFD)	0	1,000.0	1,500.0	4,250.0

[a] Million tons per year.
[b] Megawatts, one megawatt = 1,000 kilowatts.
[c] Million cubic feet per day.

to estimte changes in gross business volume, employment, and population (Table 3). Employment in the area was projected to increase by 15 percent between 1969 and the year 2000, and about one-third of this increase can be attributed to the expansion of coal mining and power generation. An increase in employment of about five thousand is projected to occur in the study area in the absence of any further energy development. Thus, employment resulting from energy development is added to this "baseline projection" (Table 3). The baseline projection was developed by first projecting final demand vectors for the study area. Final demand vectors were assumed to be gross sales of livestock, crops, mine and manufacturing products, tourist expenditures, and federal government expenditures. Interdependence coefficients were applied to the final demand vectors to obtain estimates of gross business volume by sector. Estimates of employment and population then were obtained using the procedures previously discussed. Per capita earnings undergo modest increases resulting in almost an $100 dollar increase per unit of population in 2000 when compared to the baseline estimate.

Development to Meet Regional and National Demand (CDP II)

The second policy alternative was development of Northern Plains coal resources to meet both regional and national demands, but under an assumption of substantial reliance on imports of foreign oil and gas. This policy implies that coal production in the study area would increase more than twenty-fold between 1974 and the year 2000. The coal would be used both in electrical generating plants and for conversion to synthetic natural gas (Table 2). This scenario assumes that seven gasification plants were to be built in the area between 1980 and 2000.

TABLE 3. GROSS BUSINESS VOLUME, EMPLOYMENT, AND POPULATION ASSOCIATED WITH THREE DEVELOPMENT ALTERNATIVES, SOUTHWESTERN NORTH DAKOTA

	Year		
Item	1970	1985	2000
BASELINE (NO ENERGY DEVELOPMENT)			
Gross Business Volume (Million Dollars)	$1,723.8	$1,721.7	$2,755.3
Employment	53,483[a]	52,905	58,514
Population	146,816	140,198	149,211
Per Capita Money Earnings	$2,333	$3,624	$5,598
CDP I			
Gross Business Volume (Million Dollars)	$1,723.8	$1,762.6	$2,867.3
Employment	53,483[a]	54,354	61,754
Population	146,810	144,038	157,473
Per Capita Money Earnings	$2,333	$3,677	$5,691
CDP II			
Gross Business Volume (Million Dollars)	b	$2,513.1	$3,727.1
Employment	b	68,842	89,961
Population	b	182,431	229,401
Per Capita Money Earnings		$4,121	$6,064
CDP III			
Gross Business Volume (Million Dollars)	b	$2,393.8	$4,655.9
Employment	b	78,590	121,605
Population	b	208,263	310,093
Per Capita Money Earnings		$4,370	$6,333

[a] Employment is for 1969.

[b] Same as for CDP I.

Source: U.S. Bureau of the Census, Census of Agriculture, 1969, Vol. 1, Part 18, County Table 1, U.S. Government Printing Office, Washington, D.C., 1972.

Development of this magnitude will result in substantial employment and population increases (Table 3). Employment was expected to increase by 68 percent by 1969 and 2000; and, thus, area employment in the year 2000 was 54 percent greater than projected with no further coal development. Earnings per capita indicate fairly substantial increases, with money income projected to increase over 8 percent by 2000 over the baseline situation. Furthermore, it should be emphasized that this growth will not be distributed uniformly over the study area. Rather the plants and mines will be concentrated in those areas where large strippable coal deposits are located in proximity to water supplies. Of the 18 counties of the study area, only six will likely be sites of new plant or mine facilities; and two of these six counties will possibly experience a doubling of their population by 1980.

Development to Contribute to National Energy Self-Sufficiency (CDP III)

The third policy alternative involves extensive development of coal resources to meet growing energy demands in the face of assumed major reductions in oil imports, assumed major restrictions in natural gas imports from Canada, and an assumed major lag in nuclear generating capacity. Energy activity associated with this policy was summarized in Table 2. Under this policy, the economic impacts were massive. For example, population in the area was estimated to increase 63 percent between 1970 and 1980 and 111 percent by 2000 (Table 3). Per capita income of the area will result in a 13 percent increase over the baseline projection. Development of this magnitude will pose serious challenges to state and local leaders. The provision of adequate levels of public services in areas affected by the "coal rush" will certainly by one of the major problems.

Effects of Coal Development on Agricultural Productivity

In an effort to estimate the effects on agricultural production and employment resulting from lands being taken out of production by surface mining, the following procedures were utilized. Total land in farms was broken down into two classifications: 1) cropland and 2) rangeland. The percentage breakdown of lands between cropland and rangeland was almost equal between uses; and, assuming land use patterns would not change appreciably in the future, estimation of the impacts on crop and livestock production of various levels of coal-energy development could be made. Of course, another implicit assumption was made in that land mined would be equally split between cropland and rangeland.

A third category of land (urban lands) was used in the analysis and urban land totals are in addition to total land in farms. The urban land use total per unit of population was estimated via multiple regression technique to determine the additional land requirements for population increases resulting from development. Land requirements for the additional population growth include lands needed for housing, streets, transportation, and associated facilities. The factor used in the analysis was 0.56 acres per additional unit of population.

The lands taken out of production by mining include the actual mined lands, facility sites, and reservoir storage. The mined land acreages also include the present mining and facility acreages and the mines and developments proposed to be operational by 1980. To determine the acreage disturbed beyond 1980, the developments listed under the three coal development profiles were assumed to be implemented and acreages mined were based on the estimated tonnages necessary to supply the various developments. The total land disturbed for each CDP by year was estimated and calculated as a percentage of the total agricultural lands for each of state planning regions (SR7 and SR8). This process was taken one step further in that three levels of reclamation were assumed. The three reclamation levels on acres lost to agriculture were no reclamation, 50 percent reclamation, and 75 percent reclamation. The mined lands under the various levels of reclamation for each of the CDP's were calculated as percentages of the total agricultural land. The percentages were assumed to represent decreases in agricultural productivity and were applied to the projected final demand vectors for the crops and livestock sectors (Sectors 1 and 2). Determination of the dollar loss in gross business volume, as well as the effect on employment, was determined for the three CDP's and for the study area.

Table 4 indicates the resultant decrease in employment and population by CDP and by year for the study area resulting from the three assumed levels of reclamation. The greatest decrease is observed under CDP III (the most extensive level of development) where total employment incurs a decrease of 2,287 workers and when expressed in terms of population results in a 5,832 population decrease in the study area in 1980. In the other two CDP's the effect on employment and population is much smaller as a result of agricultural lands being taken out of production due to development activities. When the mined lands are converted into a percentage of the total land base, the amount of land out of production is quite small; however, if one assumes no reclamation, this percentage will be quite substantial over a period of time. The land taken out of production varies from less than .5 percent under CDP I with no reclamation to 2.5 percent for CDP III with no reclamation.

It should be emphasized that the loss in employment and population was attributable to loss of agricultural productivity. The increases in employment and population due to coal-energy developments would outweigh the effects of lost agricultural production (at least until coal has been depleted).

SUMMARY AND POLICY IMPLICATIONS

The estimates presented indicate that coal-energy development is likely to cause major economic changes in areas with extensive and readily recoverable coal reserves. Modest levels of coal development may assist some areas in reversing a trend of economic decline. However, higher levels of development will place considerable pressure on existing public service delivery systems and may impose substantial social costs on present residents.

To avoid the disruptive aspects of coal development, public

TABLE 4. REDUCTION IN EMPLOYMENT AND POPULATION RESULTING FROM VARIOUS LEVELS OF ASSUMED RECLAMATION, CDP I, II, AND III, NORTH DAKOTA STUDY AREA, 1985 AND 2000

	1985				2000			
	Employment		Population		Employment		Population	
Baseline - - - -	52,905		140,198		58,514		149,211	
	Reduction	Total	Reduction	Total	Reduction	Total	Reduction	Total
CDP I								
No Reclamation	43	54,311	114	143,924	139	61,615	355	157,118
50 Percent	38	54,316	101	143,937	78	61,676	200	157,273
75 Percent	33	54,321	87	143,951	66	61,688	169	157,304
CDP II								
No Reclamation	214	68,628	567	181,864	558	89,403	1,260	228,141
50 Percent	107	68,735	284	182,147	393	89,568	1,002	228,399
75 Percent	102	68,740	270	182,161	343	89,618	875	228,526
CDP III								
No Reclamation	1,288	77,302	3,413	204,850	2,287	119,318	5,832	304,261
50 Percent	1,278	77,312	3,386	204,877	2,113	119,492	5,389	304,704
75 Percent	1,273	77,317	3,373	204,890	2,019	119,586	5,148	304,945

officials and planners should give serious attention to alternative means of providing and financing public services in impacted communities and areas. At the national level, attention should be given to developing alternative energy sources, as well as the encouragement and implementation of conservation methods, in the attempt to overcome our serious energy situation and achieve our goals of national self-sufficiency in energy.

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PUBLIC LAND RECREATIONAL USE: THE PATTERN FOR JOHNSON COUNTY, WYOMING

By

Cecil L. French*

THEORETICAL STATEMENT

It has been asserted by Harry, Gale and Hendee (5) that "wildernism" is an upper middle class characteristic correlated with a high education which is, in turn, associated with upper middle class occupations and an urban way of life. This constellation of traits, and especially the urban occupation, permits the development of a non-utilitarian attitude toward nature and facilitates involvement in conservation programs. Conversely, these authors state that rural residence is correlated with utilitarian views toward natural resources since the major rural occupations are generally based on the exploitation of natural resources through the relevant occupations of agriculture, fishing, lumbering and mining. Thus, opposition to the conservation movement is found among the workers in these occupations (Harry, Gale and Hendee, (5).

Devall (2) in his study of the Sierra Club, indicates that Harry, Gale and Hendee are at least partially correct when they assert that the environmentalists are upper middle class, well-educated urbanites. The Sierra Club members manifes these traits as shown by the fact that seventy-four (74%) percent have four or more years of college while forty-nine (49%) percent are in the "higher" professions. Conversely, only five (5%) percent of the males are in the clerical and sales, small business or unskilled occupational categories.

Devall (2) also points out that recent members seem to be joining because The Sierra Club symbolizes "preservation" to persons who already have these proclivities and who are seeking an association through which to become active.

Lindsay and Ogle (8) bring forth data from which they assert that the dichotomy between the upper middle classes and others in recreational use is not as strong as Harry, Gale and Hendee postulate. A sample was chosen from all urban places in Weber County, Utah. This county contains, and is nearby to, several urban centers as well as a large recreational area in a national forest. This area consists of a reservoir, picnic sites, hiking trails and campgrounds. These facilities tended to be used by local residents from Ogden and its environs and not used extensively by tourists. It was found that the users were fairly randomly distributed across the socio-economic structure rather than being drawn exclusively from the upper middle classes.

Harry (6) in commenting on Lindsay and Ogle's study, indicates that education seems positively associated with a more pristine type of wilderness use, and since the facilities in Weber County were not 'wild' areas but 'easy access areas' the implications are that although the Lindsay-Ogle study is useful it does no great damage to the assertion that a strong association exists between wildernism and upper middle class status.

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Thus, it appears from the foregoing that some grounds exist for doubting that a lack of interest in, or participation in, outdoor recreational activity exists when it is not prohibitive financially regardless of one's socioeconomic standing. But it would appear that the supposed association of 'wildernism' and wilderness use with the upper middle classes was not rendered invalid by the Weber County study.

Part of the difficulty emerging from the studies discussed above seems to be a confusion of several dimensions of what one might call an "environmentalist" orientation, and the assumption that if one dimension is observed the others are implicity present. It is not difficult to isolate what these dimensions are. Running through most of the discussion, often implicitly, are the themes of: (1) the ideology of the environmentalist social movement: (2) the socioeconomic characteristics of individuals who join "environmentalist" voluntary associations; (3) the political activities and techniques of various persons within the "movement", and (4) the outdoor recreational patterns of the individual - usually be socioeconomic status. It is our contention that these dimensions are often, but not necessarily, associated and we intend to deal with some of these dimensions in a manner which avoids the confusion of inferences drawn from one dimension with those drawn from another.

We hoped to avoid some of the limitations of extant studies by concentrating on the inhabitants of one area. Some of the difficulties accounting for the confusion discussed above seemed to us to emerge from different sampling procedures. Typically, an investigator stations himself near a facility, e.g., a primitive area, gives questionnaires to all users (University of California, Wildland Research Center, (12) tabulates these responses and finds that most of the users fit the picture drawn by Harry, Gale and Hendee of an upper middle class urbanite. Or again, he studies the characteristics of the membership in noted voluntary associations and discovers essentially the same picture emerging. The design of Lindsay and Ogle had much to recommend it, but unfortunately, they chose an area with a limited range of recreational alternatives and then seemed to generalize beyond their data to types of recreation not possible in Weber County; a failing pointed out by Harry (6).

We hoped to follow the general design of Lindsay and Ogle but avoid their major pitfall by choosing an area where a broad spectrum of outdoor activities could be found; activities supposedly exclusive to the upper middle classes as well as those presumably associated with working class status. It was felt that in this way the factor of cost could be minimized and if differential participation emerged we could point with more assurance to different value orientations as an explanatory variable.

THE STUDY

Rationale of our Study

During the summer of 1972 we gathered data from Johnson County in northern Wyoming; a county rich in recreational facilities. Available within easy reach were Cloud Peak primitive area, several reservoirs with boating and fishing facilities, numerous fishing streams, national forest with many campgrounds and picnic areas, some areas with cottages, a ski run, available private and leased land for camping, dude ranches and several historic sites. The region affords good hunting with herds of antelope, mule deer and elk. Moreover, the Big Horn Mountains have three scenic all-weather highways crossing them, each offering spectacular views for the casual tourist. The opportunities for interest and participation in outdoor recreaton of various kinds was readily available and all within about fifty miles from most inhabitants of the county. With very little cost difference in money, time or effort a Johnson County resident may engage in many leisure time activities ranging from driving for pleasure to back-packing into a primitive area. The assumption is that one's choice of recreation in this county probably reflects his orientation to the outdoors and is not strongly limited by financial considerations.

Sample

Our sample consisted of one (100) hundred adults drawn randomly from the entire county. The 1971 list of automobile licenses (13) was used after first striking off all persons whose residence was not Johnson County and limiting each person to only one license number. There were 1,986 license numbers remaining from which one hundred were drawn using a table of random numbers. The numbers one (1) and two (2) were added randomly to each number of the table. If we drew a number ending in one we interviewed the male in the household (if applicable). If the number ended in two (2) we interviewed the wife. Where the respondent was not married we ignored the closing number. Alternates were chosen from two additional tables of random numbers.

We were fairly confident our sample, albeit small, was representative of the county. When "hard" data were compared with the 1970 census data no large deviations were noticed.

Method

The interviewing was done by the investigator and his wife, always as a team. We believed that two obviously middle-aged persons would have more rapport with a population whose median age was 50 years than one person working alone, and especially in the remote areas of the county. Time of interviews ranged from about two hours to a half day.

One of the major areas of focus was upon the leisure time pursuits of the residents and especially their reported use of the outdoor recreational facilities so easily available. In this paper the dimensions of Occupation, Education, Sex of Respondent and Age of Respondent are primarily considered in their relation to general outdoor activity and to the activity of camping. Camping was chosen because of the frequent references to it in the literature, and enough persons in our sample camped to allow for some statistical manipulation.

THE RESULTS

General Outdoor Activity

Regarding outdoor recreational activity, generally (hunting, fishing, camping, hiking, etc.) forty-seven (47%) percent of our sample indicated that some form of this was now their favorite recreational practice, and another twenty-four (24%) percent stated that is once was. Of those whose activities had changed, sixteen (16) gave "age" and seven (7) indicated "health" as the reasons. Apparently then, seventy-one (71%) percent of our sample were greatly interested in pursuing outdoor activity, or had been before age and illness intervened. Table 1 shows the percentage of those preferring outdoor activity by occupational category. Table 1 also shows that the youngest occupational categories are the craftsmen, clerks and laborers while the "oldest" occupational categories are the professionals, proprietors and ranchers. A Spearman's Rank Correlation between participation in outdoor recreation and age by occupational category showed a negative association of -.83 significant at the .05 level.

A Chi square test comparing only the "higher white collars" with the "blue collars" (ranchers and clerks omitted" also showed a significant difference by age. $X^2 = 5.1$, 1 df, P. <.05, but when a Chi square was made comparing the entire sample by age and outdoor use, no significant differences emerged, ($X^2 = 2.21$, 2 df, P. <.50). Persons between thirty-five and fifty-five were slightly more "outdoors oriented" than either those under thirty-five or those over fifty-five, but not significantly so. Whether or not, then, the differential participation in outdoor activities of the various occupational categories is the result of age is problematical.

Sex of respondent does not appear to be a significant factor even though fifty-seven (57%) percent of males and thirty-seven (37%) percent of females named outdoor recreation as "preferred". The occupational picture by sex is blurred in our data in the sense that the wife (unless specifically employed) received the same occupational rank as the husband. This blurring is compounded when it is considered that outdoor recreation is often a family activity with the high possibility of passive acquiescence on the part of some family members.

In order to probe the dimension of occupational rank by "collar" we combined the categories of "Professional" with "managers" to obtain a higher white collar category and combined "laborers" and "craftsmen" to get a blue collar category. Again, ranchers and clerks were omitted since they both confuse type of work with status. Taken this way, we found that the blue collar respondents indicate that their favorite form of recreation is "outdoor" more often than do the upper white collars. A Chi square of 2.20 was not significant, but the direction was for more blue collar participation in outdoor activities.

A significant difference emerged when the formal education of respondent was examined. We divided our sample into those with high school only, or less, and those with at least some university training. We found outdoor recreation negatively associated with education in that the less educated showed the higher preference for outdoor activity. This degree of differential preference was statistically significant ($X^2 = 4.38$, 1 df, $P. < .05$).

From both the above examples; occupational type and formal education, our findings tend to support those of Lindsay and Ogle (8) in that if outdoor recreation is readily available blue collar workers use it as avidly as white collars. Still, the dimension of type of use remains: the factor which allowed doubt to be cast on the assertions of Lindsay and Ogle!

Camping

As noted, the Big Horn area affords great opportunities for a wide range of camping activities. The Big Horn National Forest has many serviced and unserviced sites as well as a plethora of attractive areas where camping is often done. For those seeking a wilderness experience the Cloud Peak Primitive area may be approached by vehicle to within one mile of its boundaries, after which all motorized travel is forbidden. Sixty-one (61%) percent of the people in our sample indicated they go on camping trips regularly. The places most used by them for camping are summarized in Table 1.

TABLE 1

Area Used	Percentage	Rank
National Forest	41	1
Wild Area	27	2
Private Property	24	3
National Parks	04	4
Public Roadside	01	5

There seemed to be no strong difference by occupational type in our sample when "camping" generally was considered, although blue collars tended slightly more toward this activity.

A contingency table comparing the upper white collars with the blue collars on the dimensions of "camp" or "do not camp" showed a Chi square of only 1.45 - not significant. About seventy (70%) percent of professionals, clerks, laborers, and craftsmen camped while only fifty (50%) percent of the managers and ranchers do so.

Other than availability of time we can postulate no factors accounting for the low participation of ranchers and managers except that of age. Perhaps ranchers obtain enough outdoor experience in their routine occupational duties, but managers, on the other hand, are often office-bound.

Table 2 shows a strong negative association between camping and chronological age. As we have seen earlier, ranchers and managers form the two "older" occupational categories.

TABLE 2

CHRONOLOGICAL AGE WITH CAMPING: COMPLETE SAMPLE

	Under 35	35 to 54	55 and over	Total
Camp	19	23	19	61
Do not camp	0	17	22	39
Total	19	40	41	100

$X^2 = 16.00$ 2 df P. $<.001$

There were no sex differences in camping. Sixty-two (62%) percent of all males and sixty (60%) percent of all females camped. But again, camping is often a "family affair."

Those least educated camped more. A contingency table comparing those with high school or less with those with some college showed a mild negative association between education and camping. ($X^2 = 3.0$, 1 df, P. $<.10 >.05$)

Equipment used in camping

While camping in general was widely enjoyed by our sample there were several methods of camping as evinced by the type of equipment used. This distribution is shown in Table 3.

TABLE 3

Type of Equipment Used	Percentage of Sample Using
Tent carried in vehicle	32
Truck and camper	25
Tent and pack horse	14
Tent on one's back	12.5
Trailer and vehicle	12.5
Only a bedroll	04.

When "equipment used in camping" was compared to occupational category it was discovered that clerks tended toward backpacking; managers led in the percentage of "horse-packers"; ranchers used trailer or camper; and craftsmen led in the "tent carried in vehicle". Since the literature on wilderness use has often considered the significance of the kinds of camping sought, e.g. "easy access" versus "deep penetration", we might point out here that since motorized equipment is not allowed in designated wild areas the use of a truck-camper, trailer or vehicle borne tent would probably indicate an easy access camper. On the other hand, "horse packers" and "back packers" are, at least, potential wilderness users.

When the white collar occupations of professionals, managers, and clerks are compared to a blue collar category comprised of laborers and craftsmen with respect to all packing, whether by horse or human back, it is seen that no differences between the two large categories emerge. Thirty-six (36%) percent of all white collars and thirty-five (35%) percent of all blue collars are "packers" and as such, potential wilderness users!

Actual Wilderness Use

Table 4 shows the distribution by occupation of the percentage of those who camp using wilderness areas. It must be borne in mind that only eighteen (18%) percent of the total sample actually used such areas.

Remembering that age varied by occupational category and that wilderness use would normally involve more vigor than other types of camping, we made a Spearman's Rank correlation between age of respondent and wild area use. A correlation of -.97, significant at the .01 percent level, may indicate that age could well be one factor operating to inhibit wilderness use. Another factor inhibiting wilderness use might be cost of equipment. Apart from taste, values, and any other inclinations, members of well-paid occupations can afford the more expensive recreational equipment if they desire it. Such equipment is usually motorized - hence illegal for wilderness use!

Again, sex of respondent did not emerge as a significant variable. About twenty-five (25%) percent of a camping females preferred the wild areas, while about thirty-five (35%) percent of all camping males named such areas as favorite.

It was noted earlier that the dimension of education appeared to be negatively associated with a preference for outdoor recreation in that the less educated preferred the outdoor type to all other forms. When the activity of "camping" was examined in association with "years of formal education" it was seen that the same direction obtained, but that the level of significance had dropped.

A consideration of education with wilderness use shows even less association than in the two previous cases. Two methods were used to test this association. One, a Chi square of those who use wilderness areas by years of education, and another consisting of occupational groups ranked by education and wilderness use. Neither of these calculations yielded any association, either positive or negative. The Chi square was only 0.28, 1df, Pn. <.90>.80, while the Spearman's Rank Correlation was only -.14.

To summarize for the dimension of education, it seems the

TABLE 4

OCCUPATIONAL CATEGORIES BY SELECTED CHARACTERISTICS (PERCENTAGE AND RANK)

Occupational Category	Prefer out-door rec.	Rank	% over 45 yrs.	Rank	% Camp	Rank	% Using Wild Lands	**Rank**	% With College	Rank	% Male	Rank
Professional Technical	23.0	6	61.5	3	69.0	3	22.0	4	96.0	1	46.8	4
Managers, Official, Prop.	46.0	4	76.6	2	50.0	5	21.0	5	36.0	4	59.0	2
Craftsmen, Foremen, Mach. Opers.	61.0	1	38.4	6	69.0	3	39.0	2	07.0	6	30.0	5
Ranch Owners, Managers	42.0	5	90.5	1	52.0	6	18.0	6	38.0	3	61.0	1
Clerical	59.0	2	40.0	5	69.0	3	42.0	1	39.0	2	00.0	6
Laborers, Non-farm	54.0	3	54.5	4	72.0	1	37.0	3	18.0	5	54.0	3

Note: Throughout this paper lengthy occupational categories will be abbreviated to the first word of each as follows: Professionals, Managers, Craftsmen, Ranchers, Clerks, and Laborers.

less educated go outdoors for recreation more often than their better educated fellow residents, but this significance drops progressively as one moves through "general camping" to "wild land use". These finds tend to support Lindsay and Ogle (8) in that no great differences emerge between the upper and lower socio-economic strata in the direction of more use by the upper strata. Strangely enough, the educational dimension, gives a kind of support to the contentions of Harry, Gale and Hendee (5)! When one moves toward the more "pristine" type of camping envisioned by wilderness users, the level of significant difference between the less educated and the better educated drops to almost nothing, even though the correlation is still slightly negative.

Since age, up until now, has emerged as a potential explanatory variable we wondered if age might not be concealed in the above calculations. Consequently, we correlated chronological age with years of education for the entire sample. Although the over forty-five age category was slightly underrepresented in the college educated population, no significant differences were found ($X^2 = 1.36$, 1df, Pn. <.30).

SUMMARY

From this sample of Johnson County residents, our findings seem contrary to the usual assertions that persons from the upper white collar occupations do the most deep camping in wild areas (University of California 12). In Johnson County, persons from blue collar occupations do more camping, but both broad occupational categories are about equally represented when both kinds of "packing" are considered. This finding lends no support to the assertions of Harry, Gale and Hendee (5).

The better educated seem to "camp" and "pack" less than the least educated but not to a significant degree. This finding is again contrary to the usual expectations and tends to support the position of Lindsay and Ogle (8).

The factor of sex of respondent seems unrelated to camping practices or to wild area use, although slightly more men use primitive areas whereas slightly more women use the national forest (easy access) sites.

Age seems to be a potential factor in explaining camping, outdoor use and packing. When occupational categories were ranked by age and outdoor use a strong negative association obtained. Age might act as a limiting factor to the more strenuous activity. It is associated with occupational rank but not with educational attainment. Not only are the campers likely to be from the less educated, lower occupational strata, they also tend to be younger.

All of these findings are contrary to the expectations when the earlier studies of Burch (1), Hendee (7) and the Wildlands Survey (12) are considered. Perhaps this discrepancy arises from the types of sampling employed by these studies which were addressed to the characteristics of users of certain types of recreational facilities. Had we stationed ourselves in front of the Cloud Peak Primitive Area and interviewed users, my impression is that our conclusions would have parallelled theirs in that most users would not be "locals". In our sample (all locals) we find that primitive area use is more in keeping with the predictions of Lindsay and Ogle (8) in that all strata seem to use the abundant outdoor recreational resources of Johnson County since cost and effort are only minimally involved.

IMPLICATIONS

Several implications may be drawn from this study. One rather ominous fact is that those persons generally thought of as elites do not participate disproportionately in wilderness activity and may have no strong interests in wilderness preservation. The younger, blue collar, less educated wilderness user may have an interest in recreational land preservation but lacks the leadership skills, confidence, organizational membership and opportunity to actualize his interests. The Forest Service practice of holding local hearings when a forest boundary or use change is imminent might elicit the loudest and most effective political response from the local elites, who may care less about wilderness preservation than we have been led to believe.

The increasing resource development and the concomitant population increase near the Big Horns will probably unleash two opposing forces. One such force is the increased use of wild areas by locals. From our study we would predict that a percentage of the new influx of working class persons will want to seek the wilderness experience with as much fervor as the middle classes. The second force will be the pressure to decrease the amount of available recreational land as the demand for resource extraction becomes greater. However these forces are balanced, it is expected that the quality of outdoor recreation, and especially the wilderness experience, will deteriorate. With this deterioration we might expect the number of out-of-area users to diminish. The absence of outsiders might then serve to reduce some of the pressure on the area, but will deprive the area of tourist dollars and perhaps, more importantly, also deprive it of some of the protection it now receives from the emotional attachment some influential outsiders now feel for it.

One other observation might be noted. The large percentage of our sample looked to public lands (National Forests or wild areas) for their recreational experience. Not many used private lands, or even national parks. Perhaps then, the Forest Service should raise the priority of recreation among the multiple uses for which public lands are designated!

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ON GENERATING USABLE SOCIAL SCIENCE RESEARCH DATA

Raymond L. Gold*

My purpose in this report is to share with you, and get your reactions to, what some colleagues (in sociology, anthropology, and political science) and I have been learning and seeking to learn about orienting our research toward the needs of those who desire to use our findings Although working on a number of independent projects, we all have in common an effort to do applied social research which will at once satisfy the utilitarian data needs of our sponsors and the expectations of fellow social scientists that we will do scientifically sound research. We also share in common the fact that our sponsors have been state and/or federal agencies which have employed us academics to help them to plan for, manage, and otherwise deal with social problems associated with industrial development in the coal-rich states of Montana, Wyoming, and North Dakota. In addition to struggling to cope with the seemingly antithetical interests of the bureaucratic and scientific members of our audience, we have been trying to teach ourselves, and lately each other, how to play applied research roles.

In an effort to cover a lot of material in a short time, I have condensed our experiences in unaccustomed research roles into a series of concise (and I trust not too highly glossed) observations. I hope that this kind of presentation will help you to join with me in reflecting on our efforts to furnish "users" with problem-solving data (users are the public agency sponsors and others who expect research findings to assist them in solving and otherwise dealing with problems--in our case, with social problems).

OBSERVATIONS

1. Most social scientists are oriented, trained, and seemingly committed to do pure research and avoid applied research. Critics of the old distinction between pure and applied research argue that the distinction is either meaningless or one of degree to those who have gotten heavily into research with both kinds of emphasis. Some suggest that the alleged difference is primarily a status distinction which is used by academics who want to justify continuing to minimize their involvement in mundane secular affairs. They further suggest that social research can be designed for use not only in dealing with today's social problems but for understanding and coping with problems of next year and five years from now.

2. Social researchers are trained and encouraged to talk and write about research findings in a language which few, if any, outsiders (and an alarmingly large percentage of insiders) can understand. Indeed, many social scientists take pride in avoiding clear, simple English prose, which they believe is nonscientific exposition.

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3. Throughout the 1960s and into the early 1970s, social science research was heavily funded, often by users who were anxious for social science to play a very fundamental, helpful role in dealing with the problems the users faced in planning for, managing, and otherwise coping with the social changes they were experiencing and anticipating. Users have found that the findings of social research usually seem to be in an unusable form, or apparently are not generalizable to the specific problems officials are concerned with, or are frustratingly out of phase with the planning or management scheme to which the officials are committed.

4. Social scientists evidently know very little about what constitutes potentially useful information for nonacademics. For example, when doing social impact research we social scientists tend to assume that public agency people and other users are as interested in local attitudes and opinions as we are when, in fact, agency people (especially at the research level) may not be particularly concerned about what the locals think. Even more painful to us may be the discovery that our standard social indicators (e.g., those pertaining to jobs, incomes, taxable evaluations) are not very useful for dealing with problems which go with social change. The standard social indicators fail to contribute much either to establishing a useful data base or to estimating social change.

5. There is a lack of established procedures for recasting general social science knowledge and particular social research data into forms which are useful in making organizational decisions, designing community programs, managing development programs, and the like.

6. Often social scientists and agency people are not well informed about the assumptions in each other's priority system, a factor in much of our mutual misunderstanding. This factor also helps to account for the mutual contempt in which agency people and social scientists generally hold each other, the former feeling that the latter are so theoretical as to be impractical, the latter feeling that the former are incapable of learning that good theory is ultimately highly practical.

7. Explaining some of the misunderstanding between the two groupings is the episodic, transitory, and fragmentary fashion in which they have contact with each other, making it very difficult to develop a common language, a common outlook or at least a working accommodation. There is simply no mechanism for keeping alive whatever may develop in the interfacing between the two groupings. (It should be noted that social scientists do not have adequate contact and communication with each other across departmental lines, let alone with users. A similar problem exists among departments in agencies.)

8. There are no guaranteed recipes for producing good communication between social researchers and users. It is the sort of thing which has to be worked out in ongoing, informal and semiformal ways by those concerned. During the process of solving their own communication problem, each of the two sides might well learn how to translate its imagery into the language of the other and then together the two might find how to

establish a common universe of discourse. The two might then even go so far as to develp information in a form which is useful to the general public they wish to serve. From all this they could conceivably learn to begin viewing each other as competent, trustworthy, and believable--a very desirable view if the researcher-user relationship is to become viable.

9. It should be borne in mind that, in spite of the attitudinal, communication, and other problems just noted, many agency people would really like social scientists to help them solve planning, management, and programming problems; and an increasing number of social scientists would like to learn how to generate data which would help meet agency needs for assistance.

10. State-level decision makers in both state and federal agencies tend to talk about everything in terms of numbers. They and representatives of industry like to believe that everything worthy of attention can be measured in terms of dollars. None of these people wants to have to give qualitative matters more than superficial or parenthetical consideration.

11. State agency people have had little or no experience working with social researchers. They are reluctant to trust social researchers to handle the large grants/contracts which the researchers require for doing projects which the agencies want done.

12. Agency officials who have had substantial experience working with social scientists report that only a small number, perhaps 10 percent, of all the social scientists they have worked with are capable of doing a good job of applied research. The remainder appear to be too ethnocentric, office bound, personally unbecoming, rigid, or otherwise unfit to play the applied research role. These experienced agency representatives have learned to be very careful about whom they select to do social research for them.

13. That a little knowledge can be a dangerous thing is illustrated by the many social science terms which have become part of laws. These terms are used in laws which direct agency activities. Through mutation or some other change process, the terms have been changed just enough to make them extremely difficult to define (e.g., try defining a "significant archaeological site").

14. If labeling, too, can be considered a "little knowledge" phenomenon, then it is well to note here that the researcher-sponsor relationship is influenced by the identity and label of the researcher, in terms of what his past actions, speeches, writings, and the like mean to the sponsor and to the sponsor's significant others.

15. The relationship between the social researcher and any particular agency person who in effect is the researcher's project sponsor is always unique in some respects; nevertheless it has much in common with his relationship with other agency persons with whom the researcher works. Accordingly, much about the relationship can be generalized.

16. One generalization about this relationship is that there is a pronounced tendency for agency people to be impatient about getting desired social data, owing to the pressures the agency people are under to solve problems concerning which social data is being gathered. There is a corresponding tendency for the researcher to try to meet unrealistic deadlines in order to help reduce this pressure.

17. It is sometimes suggested that social scientists should be better prepared to deal with agency officials than the other way around because the social scientists' training includes how bureaucracies work. Social scientists, the suggestion continues, should therefore seize the initiative in developing the researcher-agency relationship. However, to understand is not necessarily to do effectively. The fact of the matter is that not many social scientists have learned very much about how to operationalize their understandings of the human scene.

18. The researcher's reputation among agency people is affected by his method of being accountable for his findings. If the researcher does participant-observation work, for example, and therefore includes public addresses in his accountability scheme, chances are that he will be reputed to have taken a position on every issue he has studied in this way.

19. The participant-observer accountability scheme is suitable for agency sponsorship only so long as the researcher includes in his research domain the people who are going to make the major decisions concerning the problems under study. Otherwise, his data will be geared too much to informants who do not have enough to say about deciding how to deal with these problems.

20. In a public agency, management's decision-making process needs to be documented so that the agency can be properly accountable to the public and to the researchers who provided information used in the decision-making process.

21. Some researchers feel too restricted when asked to play a purely staff role. They contend that their expertise in matters concerning which decisions are being made qualifies them for more of a line role in the decision-making process.

22. In the U.S. Forest Service, the district ranger plays an important role in the decision-making process. Frequently his recommendation is followed by those up the line who eventually make the decision. This suggests that, in agencies which have comparable field officers, the field personnel who initiate decisions should receive no less attention than top management when the researcher studies and participates in the decision-making process.

23. The more the social scientist and agency person can lay out in advance of doing the research, the better they are likely to feel about each other's role in the project. The agency person needs to write down what his agency's specific problems are and what types of decisions will have to be made. The researcher needs to determine where he can fit into this decision-making process. At this stage, each party should develop guidelines, checklists, and whatever else may facilitate

making mutual understandings and expectations explicit. Expectations, rights, privileges, controls, and other rules concerning the researcher-user relationship should be specified as much as is feasible and accepted by those concerned as conditions for entering the relationship. All these matters need to be negotiated at the outset and, in the case of uneasy working accommodations, in ongoing ways as well. These negotiations, discussions, and the like should also be directed toward creating a better understanding of what the roles of researcher and agency sponsor are and should be. (When appropriate, the public and industry should participate in these negotiations, too.)

24. Just as field officers play an important role in the decision-making process, so they play an important role in problem identification. In fact, it would be well to assume that, whenever feasible, problem identification should begin in the field rather than at a higher echelon. To take advantage of the relatively great ability of field people to articulate agency problems clearly and well, social researchers should routinely establish direct links with them at the outset of negotiations concerning research.

CONCLUSION

I hope that these observations and suggestions concerning efforts of social scientists to do applied research with and for agency users have helped to clarify the essential problems and to indicate how these problems might be dealt with. Obviously, I have only touched on some of the areas of critical concern in the development of applied social research. I look forward to the opportunity to continue identifying and seeking to solve problems associated with generating usable social science research data.

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